MY BOOK OF SHIPS

Peabody Essex
MUSEUM

VM
381
.A5
1928

Phillips Library

By courtesy] THE BIGGEST SHIP IN THE WORLD—THE "MAJESTIC." *[White Star Line*

MY BOOK OF SHIPS

THEIR BUILDING AND EQUIPMENT AND THE WONDERS OF NAVIGATION ILLUSTRATED AND DESCRIBED FOR CHILDREN

BY

CECIL J. ALLEN, M.Inst.T.

and

JOHN R. HIND

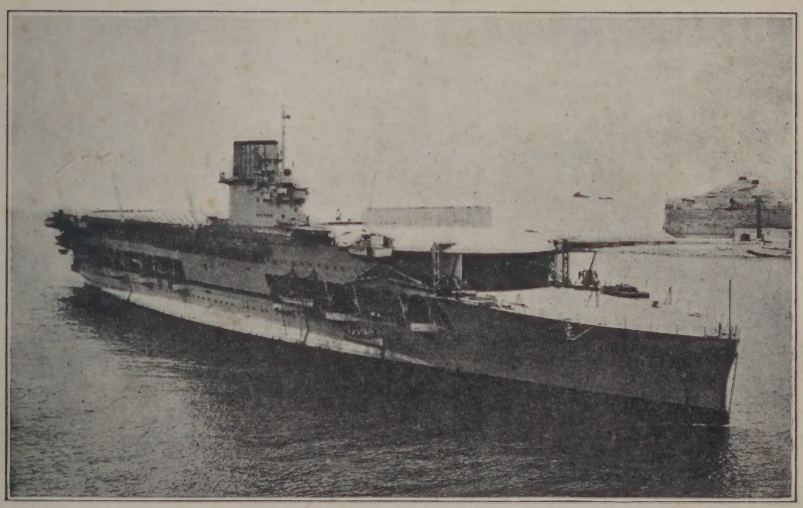


Photo by] *[Fox*

H.M. Aircraft-Carrier "Courageous"

LONDON

JOHN F. SHAW (1928) & CO., LTD.

3 PILGRIM STREET, E.C.4

VAM
381
.A5
1928

PART I

CONTENTS

	PAGE
The Waterways of the World	1
Down at the Docks	19
Yachting and Sailing	33
Wrecks and Salvage	40
Signals of the Sea	49
Life at Sea	65
The Art of Navigation	82

By courtesy] [*French Line*

AMERICA'S PRINCIPAL PORT WITH ITS AMAZING SKYLINE—
THE LINER "ILE DE FRANCE" ENTERING NEW YORK

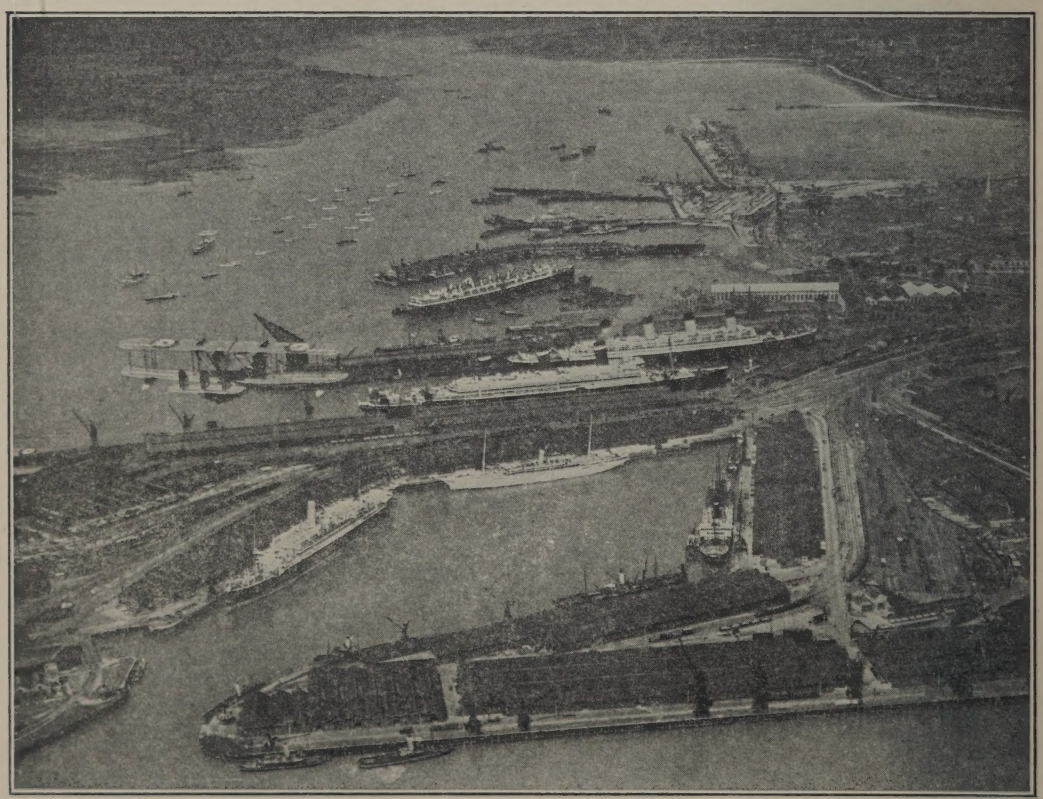
THE WATERWAYS OF THE WORLD

IT may seem strange to speak of tracks across the trackless wastes of the great oceans. But with the gradual development of the science of navigation, and the wonderful precision of the instruments and appliances which have been brought into use, so direct courses have been shaped across the seas. To-day these waterways are navigated week in and week out with well-nigh the same regularity as train services are conducted over the railways on land.

Various historic events have contributed to the making of the world's ocean routes. A group of them occurred at the close of the fifteenth century. In August, 1492, Christopher Columbus set sail westwards from Portugal, intending to find a "western" route to India and Japan. Instead he discovered the large group of islands off the American coast, which, in consequence, bear the name of "West Indies" to this day; on a later voyage he added to his discoveries that of the mainland of America.

Then the Portuguese, who, taught in the scientific school for seamen established by Henry the Navigator at Chagres, had long been making voyages down the lengthy west coast of Africa, at last overcame their superstitious fear of rounding the southernmost extremity of that great continent. Six years after Columbus had reached America, Vasco da Gama, having doubled the Cape of Good Hope, arrived at Calicut, in India. Between 1519 and 1522 Magellan went a stage further and sailed right round the world.

The opening of a route to India and the discovery of gold and silver in America had far-reaching consequences. To these discoveries of intrepid explorers there have been added, in later years, further



By courtesy] [*Southern Railway*

THE ENGLISH END OF THE TRANSATLANTIC "FERRY"—SOUTHAMPTON

Note the liners "Leviathan" and "Olympic" in the Ocean Dock and the "Mauretania" in the Floating Dock.

By courtesy] [*Orient Line*

LEAVING AUSTRALIA'S FINEST NATURAL HARBOUR—THE "ORFORD" PASSING SYDNEY HEADS

momentous changes which have been brought about by the arduous labours of the engineer. Two engineering achievements stand out above all others in the influence that they have had on the shaping of the world's waterways. The first was the completion of the Suez Canal in 1869, and the second the opening of the Panama Canal in 1915.

A glance at an atlas shows that between the two vast continents of Africa and Asia a wide indentation passes up north-eastwards from the Indian Ocean, called the Red Sea. Between the extreme tip of this and the eastern end of the Mediterranean there intervenes but a hundred miles of flat country. Traces still exist of a canal between the Nile and the Red Sea as far back as fourteen centuries before Christ. But it was not until the French engineer Ferdinand

By courtesy] [*Canadian National Railways*

A NATURAL WATERWAY—THE CANADIAN ST. LAWRENCE
Quebec Bridge—the largest single-span bridge in the world—in the distance.

de Lesseps took the task in hand in 1859 that a beginning was made on a canal deep and wide enough for ocean liners. It runs from Port Said on the Mediterranean to Suez on the Red Sea.

With various improvements which have been made since its opening in 1869, the Suez Canal is now 30 feet deep, and from 200 to 250 feet wide, enabling two of the largest liners to pass each other ; the average time of passing through is 15 hours and no higher speed than 12 knots an hour is permitted. It is at sea-level from one end to the other. This artificial waterway has absolutely revolutionized the sea routes to the East. Bombay, roughly 11,000 miles from London *via* the Cape, is only 6,200 miles distant *via* the Suez Canal. The distance from European ports to Colombo, Calcutta, and countries further east has been brought down by 4,000 miles. To Australian ports the saving is not so great ; Fremantle, for example, is 9,550 miles from London *via* Suez as compared with 10,885 miles *via* Cape Town.

Even more remarkable than the narrow strip of land joining Africa to Asia is the 1,500-mile " neck " which unites the enormous bulks of North and South America. At its narrowest, near Panama, this isthmus is but 40 miles across, as compared with more than 3,000 miles across the widest part of North America. As far back as 1550, therefore, the first ideas of a canal across the isthmus had been mooted, to save the troublesome and often tempestuous voyage round Cape Horn from the Atlantic to the Pacific.

It was not until 1880, however, that the first serious attempt was made to cut through from Colon to Panama, and once again it was de Lesseps who took the matter in hand. But this time he failed. Hilly country had to be negotiated, and the attempt to make a way through at sea-level involved a fabulous amount of excavation work in a terribly hot and malarial climate. It was not until the United States took the matter in hand in 1904, and especially when that fine engineer and able administrator, Col. Goethals, took charge in 1907, that the difficulties were overcome.

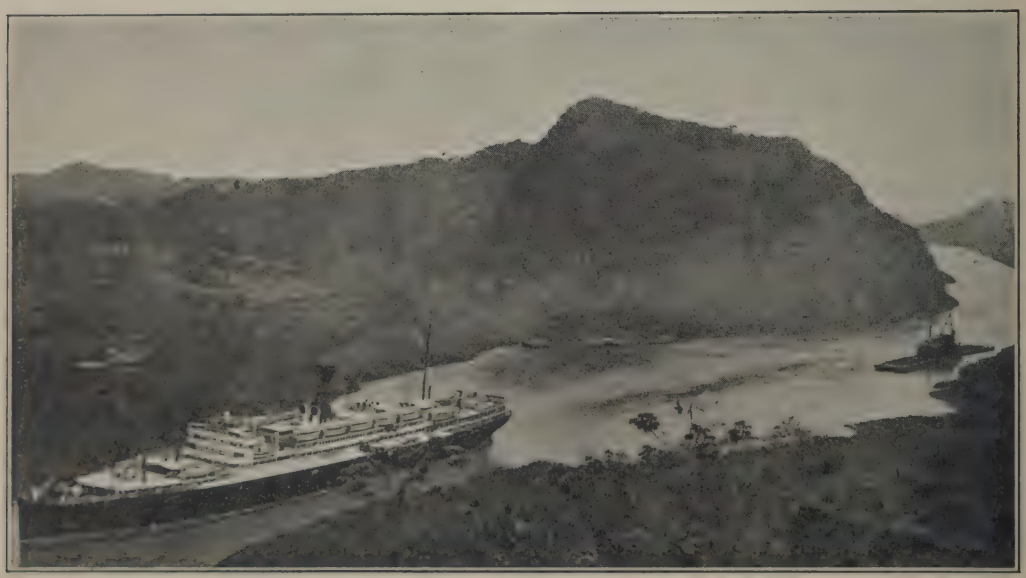
The Panama Canal passes through six locks, three together at Gatun, which lift the vessels passing through to a height of 85 feet

Photo] [*Sport and General*

AN ARTIFICIAL WATERWAY—THE SUEZ CANAL

above the sea, and three further at different points lowering the canal again to sea-level. Each of these locks is " double-barrelled," so that ships can pass in both directions at the same time, and liners or warships of the largest size can be accommodated, as the lock dimensions are in every case 1,000 feet long by 110 feet wide. The lock gates are of vast size, each of their two " leaves " being 65 feet wide, from 47 to 82 feet high, and weighing anything from 390 to 730 tons.

Other works of great magnitude were the breakwaters protecting both of the canal entrances ; that at Colon is over 11,500 feet long and that at the Pacific end, at Balboa, no less than 17,000 feet, or one-third of a mile. The worst difficulties since opening have been caused by landslides where the deepest cuts have been made through the hills—especially that at Culebra—and ten million dollars have been spent in putting some thirty of these " slides " in order.



Photo] [*Sport and General*

THE CUNARDER " SAMARIA " PASSING THROUGH THE GREAT CULEBRA CUT, PANAMA CANAL

Photo] *[Sport and General*

THE "CRISTOBAL"—FIRST VESSEL TO PASS THROUGH THE PANAMA CANAL FROM ATLANTIC TO PACIFIC—ENTERING GATUN LOCKS

Altogether the Panama Canal cost nearly 367 millions of dollars, equal to about £73,000,000. But, as in the case of the Suez Canal, this has been money well spent. Although less than nine million dollars are spent each year in working and maintaining this wonderful waterway, it is already earning some thirty million dollars a year. Nearly 6,000 vessels passed through in 1929. The use of the Panama Canal cuts the distance by sea from New York to the western ports of the United States, like San Francisco, by nearly 8,000 miles, from Liverpool to San Francisco by 5,700 miles, and from Liverpool to Valparaiso by 1,540 miles.

These canals form but two of the channels where the highways of the sea converge. They are artificial, but other famous channels are the handiwork of Nature, like the narrow Straits of Gibraltar, which separate the Mediterranean Sea from the broad Altantic. All sea

By courtesy] *[P. and O. S. N. Co.*

WESTERN GATEWAY OF THE MEDITERRANEAN—GIBRALTAR

traffic to and from Spain, Italy, Greece and South Russia must pass through this natural doorway.

The busiest stretch of open sea in the world is probably that between the south of Ireland and the westerly French headland known as Ushant. Here the English Channel, the Bristol Channel and the St. George's Channel merge into the Atlantic, and here is focussed the sea traffic to and from many of the world's most noted ports—London, Southampton, Liverpool and Bristol in England, for example; Cherbourg and Havre in France; Antwerp in Belgium; Rotterdam in Holland; and Hamburg and Bremen in Germany—in fact, practically the whole of the import and export trade of Western Europe passes this way.

Another natural highway is the narrow channel to the north of Denmark. Its westerly leg is known as the Skagerrak and its easterly leg as the Kattegat. This gives access to the three Scandinavian capitals—Oslo, Copenhagen and Stockholm—as well as to the North German coast, the new post-war countries of Poland, Latvia and Esthonia, to Finland and to the one-time Russian capital of Petrograd,

now known as Leningrad. Here again human ingenuity has cut off the tremendous " corner " of the Skagerrak and the Kattegat by means of a 53-mile ship canal—the Kiel Canal—cutting right through south of the base of Denmark into the Baltic Sea.

The Baltic is one of those important waterways which is only navigable for a portion of the year, as during the depth of the winter a great part of it is frozen over. Powerful icebreakers keep certain of the chief routes open between the countries which border on it, while the remainder of the sea traffic is virtually at a standstill for three months. The port of Archangel, in the extreme north of Russia, is even more unfortunate, as it is only for six months in the year that the White Sea is sufficiently free of ice for vessels to make their entry.

Further important concentration of traffic takes place on the western side of the Atlantic, between Cape Race—the most south-easterly point of Newfoundland—and Long Island, off New York. Here

Photo] [*Fox*

A Unique View of Gibraltar and its Harbour

is focussed the busy sea traffic with the chief ports of the United States—New York, Boston and Baltimore—and the Canadian ports of Halifax, Quebec, Montreal and Toronto. In this part of the world the question of ice is also one of great importance. For an average of three to four months in the year the River St. Lawrence is frozen right over, so that to and from Quebec, Montreal, Toronto and the great chain of inland lakes—Ontario, Erie, Huron, Michigan and Superior—to which the St. Lawrence gives access, all the traffic by sea is confined to the remaining eight months or so. Thus winter conditions have a very vital effect on Canadian exports, especially that of grain from the great prairies of the Middle West, which as far as possible must be rushed away between the harvest and the freezing up of the river.

Not only in inland waterways, but also in the open Atlantic, does ice make itself felt. Here it is not so much an obstruction as it is a peril to navigation. In the Spring and Summer, under the influence of warmer weather, the great ice barrier of the Arctic Ocean begins to melt. Great masses of it break away and are carried southwards

By courtesy] *[Cunard S.S. Co.*

THE FAMOUS PORT OF LIVERPOOL

In the background is seen the striking outline of the Royal Liver Building.

by the sea currents. These pieces are in the shape of icebergs, often of gigantic size. It is on record, indeed, that bergs have been seen up to 200 feet in height above the waterline, and there is a much greater bulk under water than the beautiful and sinister towers and pinnacles of ice which appear above. Any ship striking one of these bergs, which, to make matters worse, are often shrouded in fog, is in grave peril, and not a few disastrous losses of ships at sea have occurred in this way.

By courtesy] AN ATLANTIC PERIL—FLOATING ICE *[Royal Mail*

Between the beginning of February and the end of August, therefore, the " C " tracks used by all the chief shipping companies across the Atlantic between Europe and the North American and Canadian ports are moved further to the southward, to what are known as the " B " tracks, even at the expense of a slightly longer journey. If the ice conditions are abnormally bad, from April 1 to June 30 the " Extra Southern," or " A " track, is followed, even further to the south. In addition, patrol boats are now sent out regularly at the appropriate season from the American side, where the conditions are the worst, to watch for icebergs and give warning to all shipping in the vicinity.

LUXURY—THE ROYAL MAIL MOTOR-SHIP "ASTURIAS"

It was an American naval officer named Lieut. Maury who first pointed out in 1855 the desirability of definite "lanes" of traffic across the Atlantic, differing for outward-bound and homeward-bound ships, and these standardised routes have now become general. Ships steaming in opposite directions thus keep well out of each other's way, but, more important still, in the event of a breakdown the vessel concerned is directly in the track of following steamers.

The finest, fastest and most luxurious liners in the world maintain the service of the "Atlantic Ferry," as the 3,100-mile journey between Southampton and New York is sometimes humorously called. Since regular Transatlantic voyages with steam-vessels were first instituted by the Cunard Company in 1840, there has been incessant competition as to which line can secure and hold the "blue riband" for speed and size. The chief British competitors are the Cunard and the White Star Lines, the former of which for 22 years held the speed record with the world-famous *Mauretania*, while the latter holds the record for size with the 56,620-ton *Majestic*.

Latterly the North German Lloyd and the Hamburg-American lines, which are now amalgamated, have entered the lists, and for the time being claim the supremacy in speed with the sister ships

Bremen and *Europa*. Strong Transatlantic competition is also offered by the leading American, French and Italian steamship companies, known respectively as the United States Lines, the Compagnie Generale Transatlantique, or French line, and the Navigazione Generale Italiano.

In earlier years the British Transatlantic traffic concentrated chiefly on Liverpool. But by degrees it has gravitated to Southampton, because a departure from Southampton allows a liner to run quickly across the English Channel to Cherbourg, and there, with but little loss of time, to secure a share of the all-important traffic to and from the Continent of Europe. Some lines, particularly the French Line, make their British call further down Channel, at Plymouth, as this saves a good deal of time by avoiding the run up the Solent and Southampton Water and back after they have left Cherbourg. At Plymouth the liners do not come alongside, but are met by steam tenders outside the Sound.

Between England and Canada the Cunard Company has a formidable rival in the Canadian Pacific Railway, which maintains a fleet of fast luxury-liners to and from St. John, New Brunswick. Connected by the main line of the C.P.R., right across Canada, the same

By courtesy] [*Swan, Hunter, Wigham Richardson*

UTILITY—THE FRUIT-CARRYING SHIP "AMAPALA"

company runs another steamship service across the Pacific Ocean, between Vancouver and the Pacific Islands, the Far East, Australia and New Zealand. Thus this enterprising railway well-nigh girdles the whole globe with its own " all-red " railway and steamer routes.

We have now to think of the waterways eastwards from England, serving the great Continents of Asia, Africa and Australia. In olden days the routes followed by sailing ships were governed chiefly by the trade winds, or the settled winds which may be expected generally to blow in different parts of the world. Now that sails have mainly given place to steam or oil as a propellant, however, other considerations have come into force. Among these the most important is refuelling. The Atlantic liner carries in her bunkers sufficient coal or oil, with the necessary margin over these requirements in case of emergency, for the journey across. But on the longer voyages to the East too much valuable cargo space would be monopolised by fuel were sufficient taken on board at the starting-point for the full distance. There are, therefore, certain well-known coaling stations at which all vessels call to replenish their bunkers, with coal or with oil, as the case may be.

By courtesy] *[Orient Line*

EASTERN GATEWAY OF THE MEDITERRANEAN—PORT SAID

By courtesy] *[Union Castle Line*

AT CAPE TOWN—THE "ARUNDEL CASTLE"
Table Mountain is seen under its characteristic "tablecloth" of cloud.

Going east, the best-known British stations are Gibraltar, at the entrance to the Mediterranean, and Port Said, at the entrance to the Suez Canal, with the island of Malta midway between; Aden, where the Red Sea merges into the Indian Ocean; Colombo, in Ceylon; Penang and Singapore, at the southernmost extremity of Asia, and Hong Kong. Another call often made is at Marseilles, the busy port in the South of France, which enables mails, and passengers who have left London some days after the departure of a liner, to travel by rail across France and catch her up.

The steamers of the old-established Peninsula and Oriental Company (the "Peninsula" is, of course, India) travel this way, one service running to Bombay, another to Colombo, Madras and Calcutta, and another to Singapore, Hong Kong, Shanghai and Japan. Yet another crosses from Aden to Fremantle—at the western extremity of Australia—and then skirts the South Australian coast to Adelaide, Melbourne, Sydney and Brisbane—four Australian capitals. This is conducted by the associated Orient Line, whose steamers

By courtesy] *[Norddeutscher Lloyd*

A WELL-KNOWN GERMAN PORT—BREMERHAVEN
The famous Steamer "Bremen" is seen alongside the Quay.

are noted for their palatial equipment and for their graceful and distinctive external lines. The North German Lloyd Company is also responsible for important services eastward, from Bremen and Hamburg to India, China and Australia.

Passenger traffic to and from West, South and East Africa is largely catered for by the amalgamated Union and Castle Lines. Like the vessels of the Peninsula and Oriental and the Orient Lines, many of the Union-Castle liners begin their voyages from London or Tilbury, making thence for Madeira. From the Canary Islands some of the vessels shape a direct course for the Cape, afterwards passing up the east coast to Durban and East African ports. Others turn inwards from Madeira to the Gold Coast, the Ivory Coast and the ports at the mouth of the Niger and the Congo.

Yet another direction of travel of great and increasing importance is that linking Great Britain with the West Indies and Central and South America. Here it is the Royal Mail Steam Packet Company which

By courtesy] *[Royal Mail S.P. Co*

THE MOTOR-LINER "ALCANTARA" ENTERING THE HARBOUR AT RIO DE JANEIRO.

chiefly holds the field. The principal Royal Mail services make direct from Liverpool or Southampton, calling, perhaps, at Cherbourg or Lisbon and at the lonely Azores Islands, in mid-Atlantic, for Rio de Janeiro, the port which figures in that popular ditty " Rolling down to Rio." Then follow Santos, also in Brazil, Monte Video, the capital of Uruguay, and, across the broad River Plate, Buenos Aires, the teeming capital of the Argentine Republic. The services of the associated Pacific Steam Navigation Company make for the west coast ports of South America, such as Lima and Valparaiso, reaching them through the Panama Canal, and others are directed to the islands of the West Indies, and the ports of Mexico and the smaller states in the north of the South American Continent.

These are but a few of what can be called the chief waterways of the ocean and the principal passenger services making use of them ; others innumerable might be named did space permit, especially the important lines which concern themselves chiefly with freight. The bulk of the British shipping interests are now amalgamated into

By courtesy] [*Royal Mail*

A Royal Mail Liner on Holiday at Ulvik, Norway.

large groups, the principal of which are those associated with the names of Lord Kylsant (the Royal Mail, White Star, Union-Castle, and other lines), Lord Inchcape (the P. & O. and the Orient), and the Furness-Withy, Cunard and Ellerman groups.

There are, in addition, other marine activities of great interest. For example, the greatest flow of traffic over the best-used routes takes place in the Spring and the Autumn. What happens to the superfluous vessels in the intervening months? Winter is the time for overhaul, but in Summer some of them take holidays from their usual routes by cruising in unusual directions. The land-locked "fjords" which penetrate the west coast of Norway make one happy hunting-ground; the Baltic, with the capitals fringing on it, is another; the wide reaches of the Mediterranean another.

There is less glamour about the slow and sometimes unsightly freight steamer on "tramp" than that which surrounds the swift, graceful and luxurious ocean greyhound. But we do well to remember that the bulk of the shipping companies' revenue is derived from the carriage of freight rather than of passengers. Most of the passenger services at sea, indeed, could not be run at a profit apart from the varied cargoes carried by the vessels in their holds.

A tramp steamer has a more or less roving commission. The purpose of her owners is, as far as possible, to see that her holds are always full. That is to say, wherever cargoes are discharged it is hoped to take on other cargoes which will enable the vessel to run profitably on a long continuous cruise. An astonishing catalogue might be made of the various commodities thus carried from port to port by a "tramp" which, in the course of a voyage from her port of registry lasting anything up to nine months or so, may easily cover twenty thousand miles and travel three parts of the way round the world.

By courtesy] [*L.N.E.R.*

COALING HOISTS AT IMMINGHAM.

DOWN AT THE DOCKS

THERE is much of importance to be done when a ship is in port. Cargoes must be loaded and unloaded, and for carrying out this work conveniently and quickly appliances of all kinds are necessary. It is vital, too, that the ship shall be in a sheltered position while this work is being carried on, and not at the mercy of rough seas or big rises and falls of the tide. And then, again, there is the work of overhaul, which must be carried out very thoroughly from time to time, and for attention to the hull the ship must be lifted high and dry out of the water. For the ordinary work of the port, therefore, docks are provided; but the special operations last-mentioned require the provision of a dry dock or a floating dock, of which more presently.

Some ports are fortunate enough to be situated in sheltered positions where there is but little rise and fall in the tide, such as Marseilles, Genoa and Naples, on the Mediterranean, and here the ships lie in open basins, in harbours protected from the open sea by breakwaters.

Other of the world's most important ports are located on rivers, estuaries or inlets of the sea, where miles of quayage have been laid, or a series of basins have been constructed like docks without gates, so that ships can come alongside at all states of the tide. This is the case at Southampton, at the head of Southampton Water; Glasgow, up the River Clyde; Antwerp, on the Belgian River Scheldt; the German port of Hamburg, on the River Elbe; New York, and elsewhere. The chief disadvantage of this method is that some of these waterways are narrow and tortuous, so that time is lost in navigating them safely, while there is a liability to further delay, in certain cases, on account of fog, especially in such a river as the Scheldt.

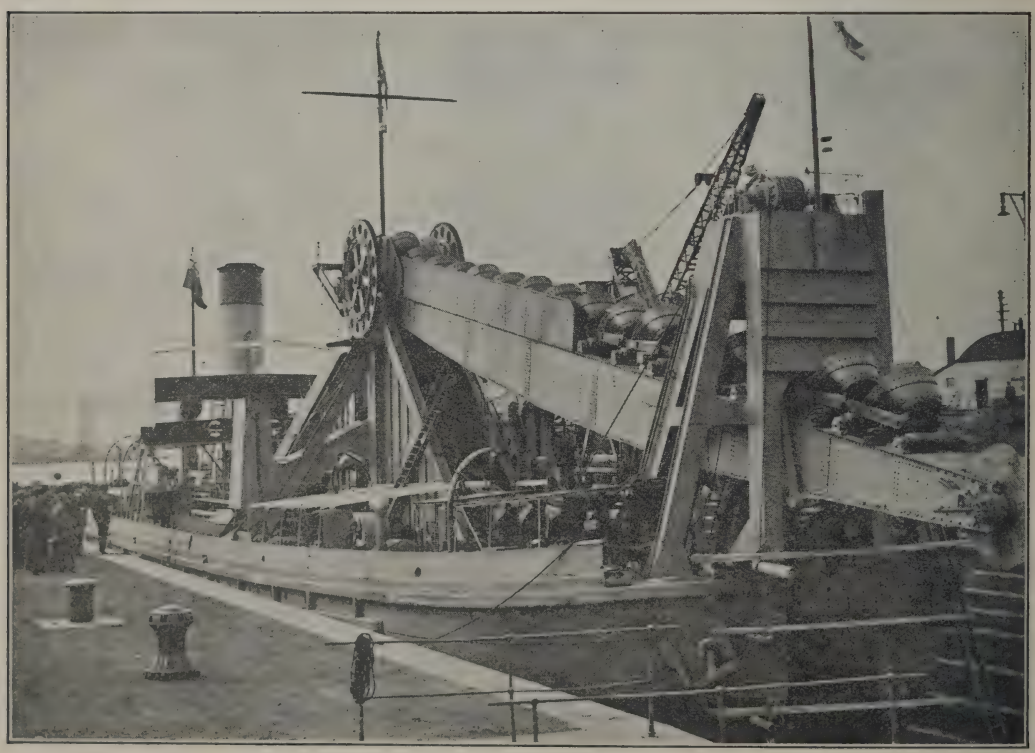


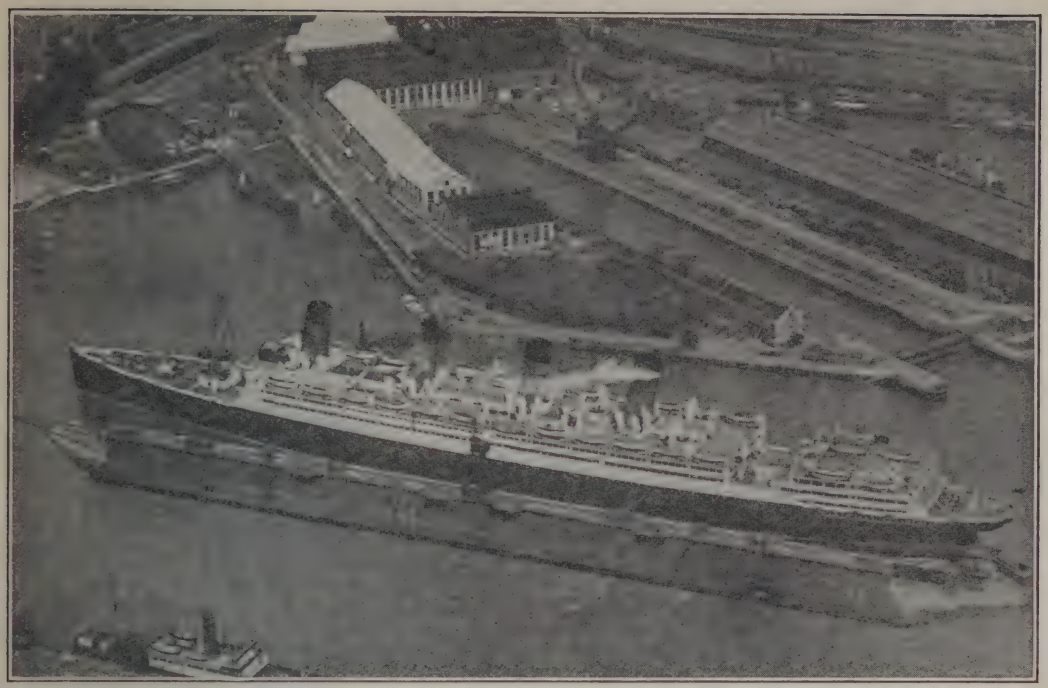
Photo by] *[Sport and General*

A Modern Dredger of the "Ladder" Type

Used to maintain the correct depth of channel in harbours and navigable waterways.

[From Photo by courtesy] [Cunard S.S. Co.

THE "OLD LADY" BREAKS A RECORD—A STRIKING VIEW FROM THE DECK OF THE "MAURETANIA," STEAMING AT FULL SPEED.



By courtesy] *[Cunard S.S. Co.*

THE PORT OF SOUTHAMPTON.
The Graving Dock is seen behind the Floating Dock, which holds the "Aquitania."

But the advantage is that of a perfectly sheltered harbour, where quayage can be constructed at a minimum of cost. A port like Southampton scores in that it has the unusual combination of a deep and sheltered sea inlet, fed by two rivers, with only 13 ft. maximum rise and fall in the tides, so that, by dredging the quay approaches to a depth of 40 feet or thereabouts it is possible for the biggest liners to come alongside them at all states of the tide. This, coupled with the accessibility to Southampton of the important European ports on the other side of the English Channel, is the reason for the growing attraction exercised by Southampton over the Transatlantic shipping companies.

Strictly speaking, however, open basins and quays do not come under the heading of docks, though they are often so described. The simplest form of dock is a closed basin, shut in by gates ; a ship

By courtesy] [*L.N.E.R.*

THE ALEXANDRA DOCK AT HULL.

Note the Branch Docks opening off the Main Dock and the entrance lock, beyond the riverside landing-stage

is brought into it through the open gates when the tide is suitably high, and then the gates are closed, retaining the same depth of water inside the lock continuously. Entrance and exit are only possible when the tide is at the same level. In modern docks, however, in order that traffic in and out may not be limited only to the period of high water, a lock or a pair of locks are arranged between the waterway and the dock, by means of which vessels can pass to and fro at all states of the tide. It is, of course, possible to arrange a floating landing stage in a tidal waterway, secured to the bank by steel girders and rising and falling with the tide, but this is provided chiefly for the embarkation and disembarkation of passengers, and would not be suitable for handling cargo. Notable landing stages of this character are found at Liverpool, on the Mersey, and at Tilbury, the growing port near the mouth of the Thames.

The dimensions of some of the modern docks are enormous. Tilbury Dock, for example, consists of one main dock throwing off at right angles three large branch docks and three dry docks ; by

means of a new lock recently built, the main dock can now be entered from both ends. This new lock is 1,000 feet long by 110 feet wide, and has a maximum depth of water of 41 feet at high tide. The dock itself is 38½ feet deep and covers 72 acres. The Gladstone wet dock at Liverpool has an even larger lock, measuring 1,070 feet by 130 feet and 43 feet deep, which is of more than ample size to take the biggest vessels afloat. The gates of a lock of this character are of prodigious size. Modern examples are usually of steel construction, faced on the edges which make the watertight contacts with greenheart timber, and hollow inside, so that the movement of the gates in the water may be assisted by their buoyancy. Each of the Gladstone lock-gates at Liverpool weighs 496 tons. Hydraulic or electric power is

By courtesy] [*Stothert & Pitt Ltd.*

DISCHARGING A CARGO OF IRON ORE.

The grab crane has seized a load from the steamer's hold, and is discharging it into the chute, from which it is falling into a railway wagon.

provided for opening and closing them.

Elaborate equipment must be provided at the quayside for handling the ships' cargoes. The general arrangement is to leave a wide space alongside the quay, on which two or three lines of rails have been laid. On the opposite side of this space are the dock sheds, where much cargo is stored temporarily before or after shipment. Other cargo is passed direct to and from railway wagons on the quayside. The work of handling is performed by a line of movable cranes, usually 100 to 120 feet apart, and with a lifting capacity of $1\frac{1}{2}$ to 5 tons. These cranes are of all kinds and descriptions, electrically or hydraulically worked. Sometimes they straddle across a line of railway, so that wagons can pass underneath; sometimes, as at Gladstone Dock, Liverpool, they are arranged on the roof of the dock sheds.

By courtesy] *[Stothert & Pitt Ltd*

A 5-TON DOCKSIDE CRANE AT SOUTHAMPTON.

In addition to cranes, all manner of special appliances have been devised for dealing with special cargoes. Chilled meat and frozen meat, for example, are run by electric conveyors, runways and hoists straight from the holds of the

By courtesy] [*L.N.E.R.*

Shipping Coal at Hull.

ships into the cold storage warehouses at the dockside. Grain is sucked by pneumatic power or run by bucket conveyors from the great grain elevators into the ships, and then is discharged into granaries, on reaching port, by means of floating pneumatic elevators.

But it is the shipment of coal which requires the most elaborate and complicated plant. A number of British ports have been specially equipped for rapid handling of export coal, especially Immingham and Hull, on the Humber, and the South Wales ports of Newport, Cardiff, Penarth, Barry and Swansea. Each dock is lined with great rows of coal hoists, which seize the railway wagons bodily, raise them to a suitable height above the steel shoots running down into the ship's hold, and then tip them, so that their contents are discharged through side or end doors down the shoots. It is important

By courtesy] [*L.N.E.R.*

SALT END OIL JETTIES, HULL.

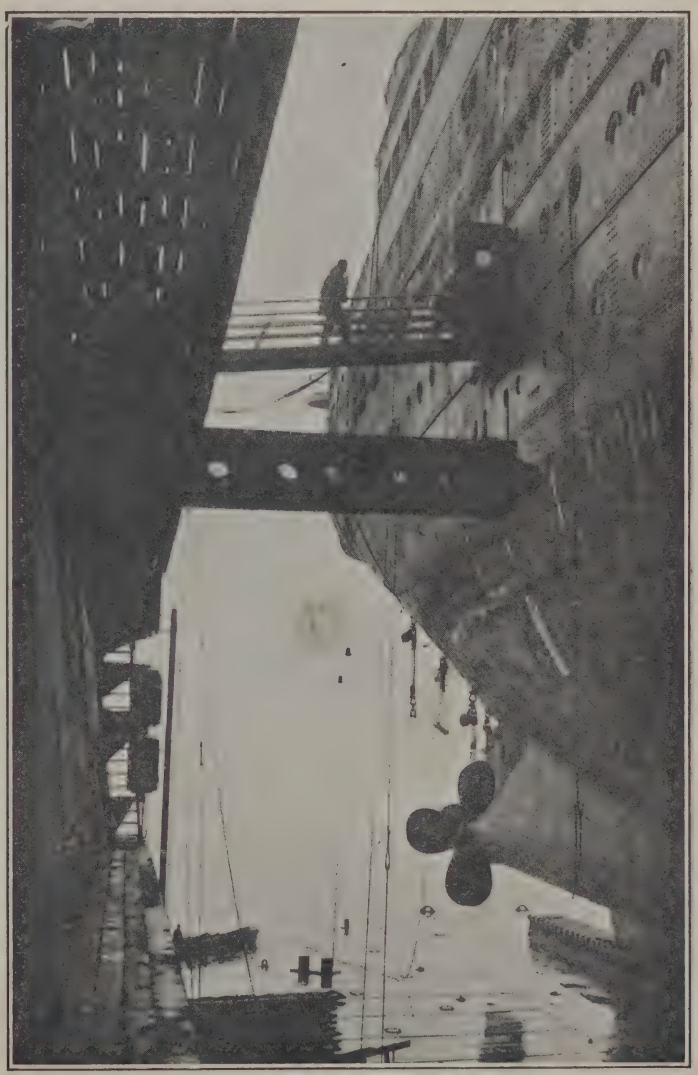
when shipping coal to avoid breaking it up, as its value when broken into small pieces is much less, but the anti-breakage appliances used tend to slow down the work of handling. Some of the latest British coaling plants, such as that at Newport, Monmouthshire, where 20-ton coal wagons are in general use on the railways, can load coal up to 850 tons an hour. But this falls short of the latest American plants, where enormous coal wagons, of capacities reaching 100 tons

By courtesy] [*L.N.E.R.*

SALT END JETTIES—THE SHORE END.

and more, are in use. At the Baltimore coaling pier, which is 700 feet long and has four main coaling towers, 40,000 tons of coal have been shipped in a single day.

Another commodity requiring special methods of handling is oil, which nowadays is carried across the sea in vast quantities. Owing to the risk of fire, the berths where oil is taken on board the "tankers," and where it is discharged, are usually well isolated from the ports at which they are located. Jetties are constructed in the waterway, and connected with the shore by a light staging carrying the pipes through which the oil is pumped into the great containers on land. The Salt End Jetty, in the River Humber below Hull, is a good example of modern methods of dealing with oil in bulk.



Photo] [*Photopress*

A Giant Liner in the Floating Dock.

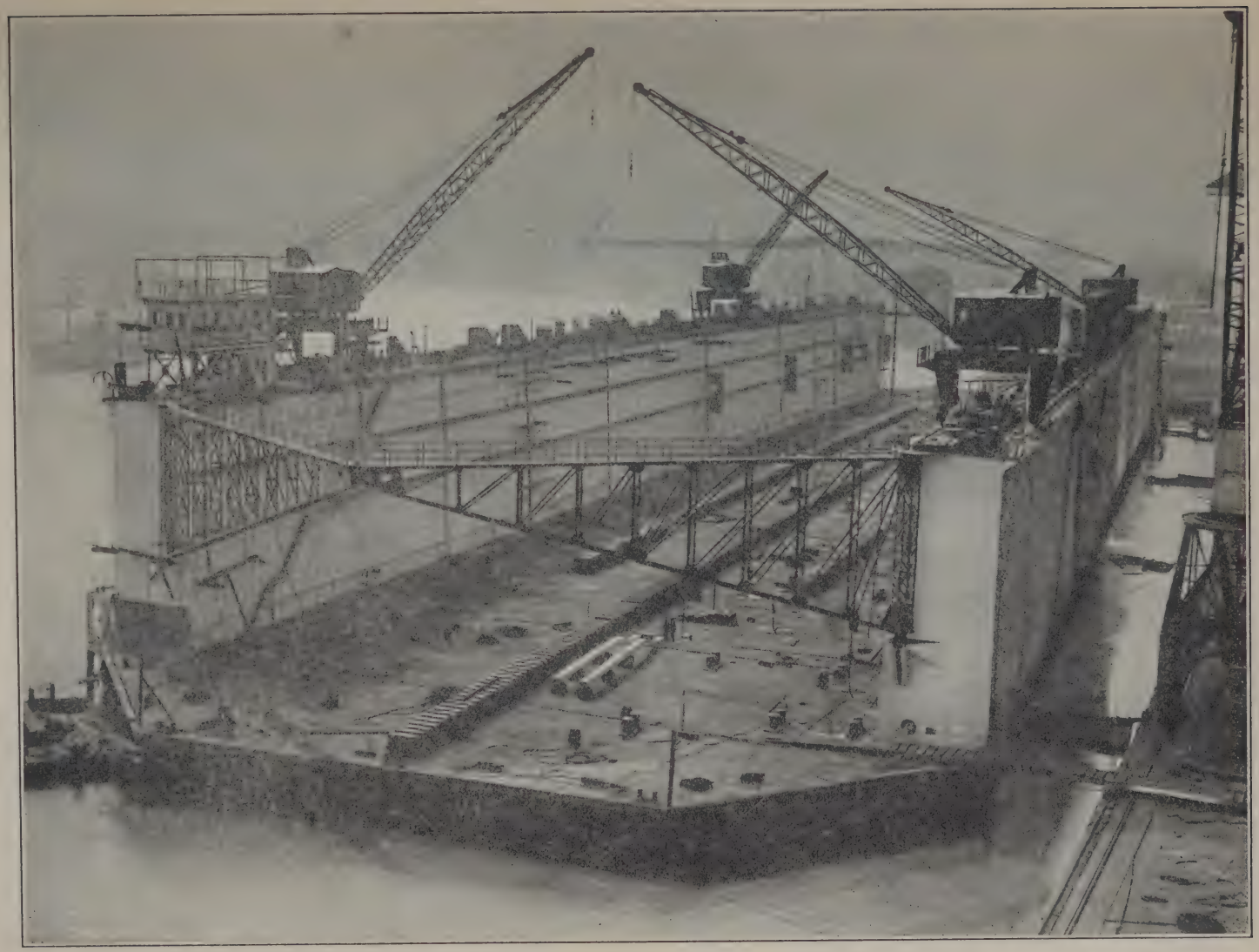
Note the steel shore in foreground which helps to centre the vessel in the dock.

But the most interesting of all docks

are those in which ships are docked for cleaning and examination of their hulls. A dry dock is designed somewhat on the lines of a lock. The vessel enters through the customary entrance gates, which are then closed. After she has been centred by means of shores, the water is pumped out of the dock until the vessel is resting securely on her keel, when bilge-blocks are inserted along both sides of her bottom to keep her steady. The remaining water is then pumped out, and the ship is left high and dry. Docks of this type are sometimes called "graving" docks, owing to the scraping, cleaning and tarring operations carried on in them.

The floating dock is a more recent development, designed to deal in an expeditious way with the very biggest ships. No finer example could be given than the Southern Railway Company's giant dock at Southampton—the biggest in the world—which figures in several illustrations. This is an enormous steel structure, containing 17,240 tons of steel. The floor, or pontoon, 170 feet wide and 20 feet deep, is honeycombed with hollow spaces, and similarly the two sides, each of which is 50 feet in height above the floor, and from 18 feet thick at the base to 12 feet thick at the top. Overall the length of the dock is 960 feet and of the two side walls 756 feet; both ends are open and afford a clear width of entrance of 134 feet.

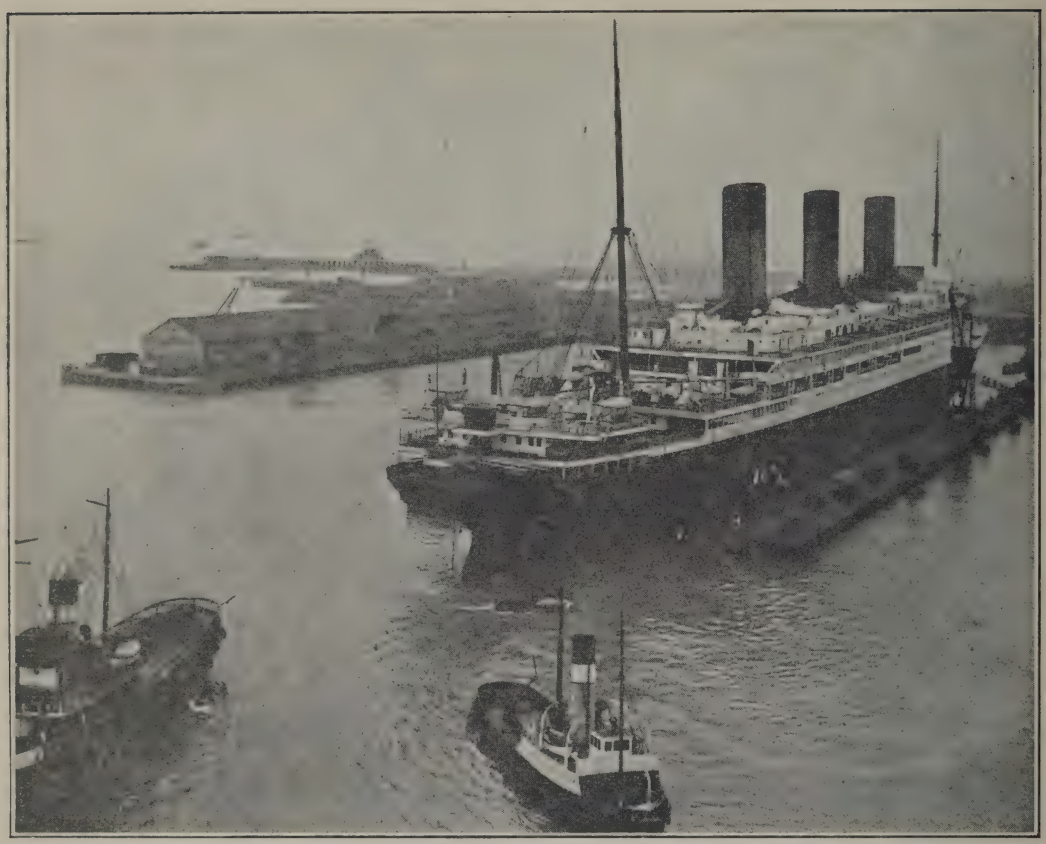
The principle of working is, first, to allow water to run into the hollow spaces of the bottom and sides, sinking the whole dock until only 7 feet of the side walls remain above water. Some $3\frac{1}{4}$ acres of space occupied by the dock have been dredged to a depth of over 70 feet, to enable this to be done. The vessel to be dry-docked then passes slowly, in charge of a number of tugs, into the dock. Great care is taken to get her exactly centred, and in this position she is secured by four powerful electrically-operated shores from both sides, so geared that each pair moves out towards the centre exactly in unison. Eighteen centrifugal pumps now set to work to



By courtesy] [*Swan, Hunter, Wigham Richardson*

THE SINGAPORE FLOATING DOCK.

Note the keel-blocks down the centre, the travelling cranes on each wall, and the hinged bridge giving communication from one wall to the other.



Photo] [*Photopress*

THE "MAJESTIC" ENTERS THE FLOATING DOCK AT SOUTHAMPTON.

pump the water out of the dock structure, during which it gradually rises higher and higher out of the water. Very soon the keel of the liner is resting on the row of keel-blocks down the centre of the dock, and two side rows of adjustable bilge-blocks help also to distribute the vast weight of the vessel over the dock floor, as well as to keep her perfectly stable.

Even the 56,620 tons of the giant *Majestic* have been lifted high and dry out of the water in no more than four hours, during which time 80,000 tons of water were pumped out of the dock. But still bigger ships than this can be accommodated, as the dock is designed to take a 60,000-ton vessel.

The Singapore floating dock is another fine example of British enterprise in this direction, and falls but little short in size of its Southampton relation. It was built for the Admiralty. Perhaps the most interesting feature of this last dock is that it made the whole of the 8,600-mile journey from Wallsend-on-Tyne to Singapore by sea. Four powerful tugs were entrusted with the task of towing this 50,000-ton structure, and completed their ticklish feat of navigation in roughly five months. The most difficult part of the towage was the manœuvring of this singular craft through the confined width of the Suez Canal, and those responsible for the voyage probably breathed more freely when their vast charge was safely across the turbulent waters of the Bay of Biscay. But these and all other difficulties *en route* were triumphantly surmounted, and the dock is now upholding in the East, not only British ships, but the prestige of British shipbuilders.

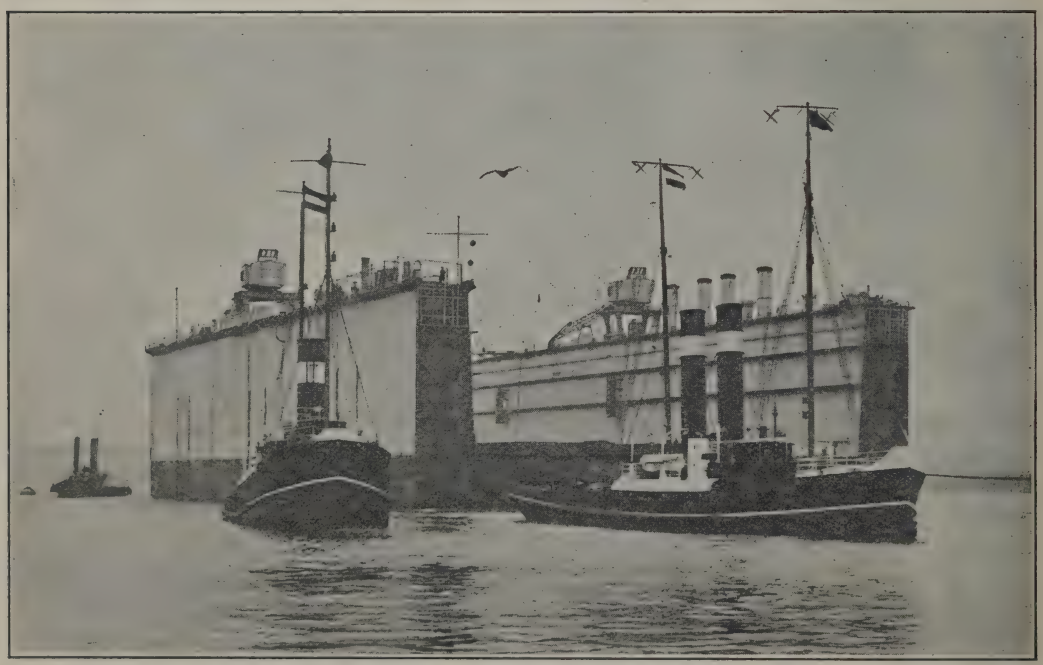
In attendance on the floating dock at Southampton is a gigantic floating crane, capable of lifting no less than 150 tons at a time, and

By courtesy] [*White Star Line*

RISING OUT OF THE WATER. THE "MAJESTIC" PARTIALLY LIFTED.

of swinging such a load round at a radius of over 100 feet.

Another important item of harbour equipment is the dredger. The action of tides and storms on sandy sea-beds causes constant trouble in harbours by silting; and with the coming of bigger liners navigable waterways have to be dredged out to greater depths to provide navigable channels. Dredgers are of many different kinds, according to the material to be dealt with. The commonest is the "ladder" dredger, with its endless chain of buckets, as seen in the illustration on p. 20. The circular movement of the chain causes the buckets to scoop a channel out of the sea-bed; they bring up the excavated material and discharge it into hoppers for removal. Other kinds of dredgers are the "dipper" and the suction dredger, but the latter can only be used where mud, sand or some other soft material has to be dealt with.



By courtesy] [*Swan, Hunter, Wigham Richardson*

ON THE WAY EAST—
THE SINGAPORE FLOATING DOCK SETTING OUT ON ITS 8,600-MILE JOURNEY.

By courtesy] [*L.N.E.R.*

ONE OF THE SAILORS' SIGNPOSTS—LONGSTONE LIGHTHOUSE

An Exciting Moment in a Race for Small Yachts—Rounding a Mark Buoy on the Norfolk Broads

YACHTING AND SAILING

[*All photographs in this chapter by courtesy of L.N.E.R.*]

THERE is a fascination about gliding in a sailing yacht over the surface of the sea or a stretch of water inland. Progress seems effortless. The throb of a steamer's engines or the noisy purr of the motor-boat are replaced by the wash and the lapping of water as the graceful vessel cuts her way cleanly through. It is small wonder, therefore, that this splendid sport lays its hold on all sorts and conditions of people, from His Majesty the King himself down to some of the humblest of his subjects.

The principles of yachting, whether applied to a large yacht or a small cutter, are essentially the same. From a central or principal mast the mainsail hangs by means of ropes and a spar. Additional

BRINGING IN THE AIR PILOT—HOW A CUTTER AND DINGHY LINK THE SEAPLANE WITH THE SHORE

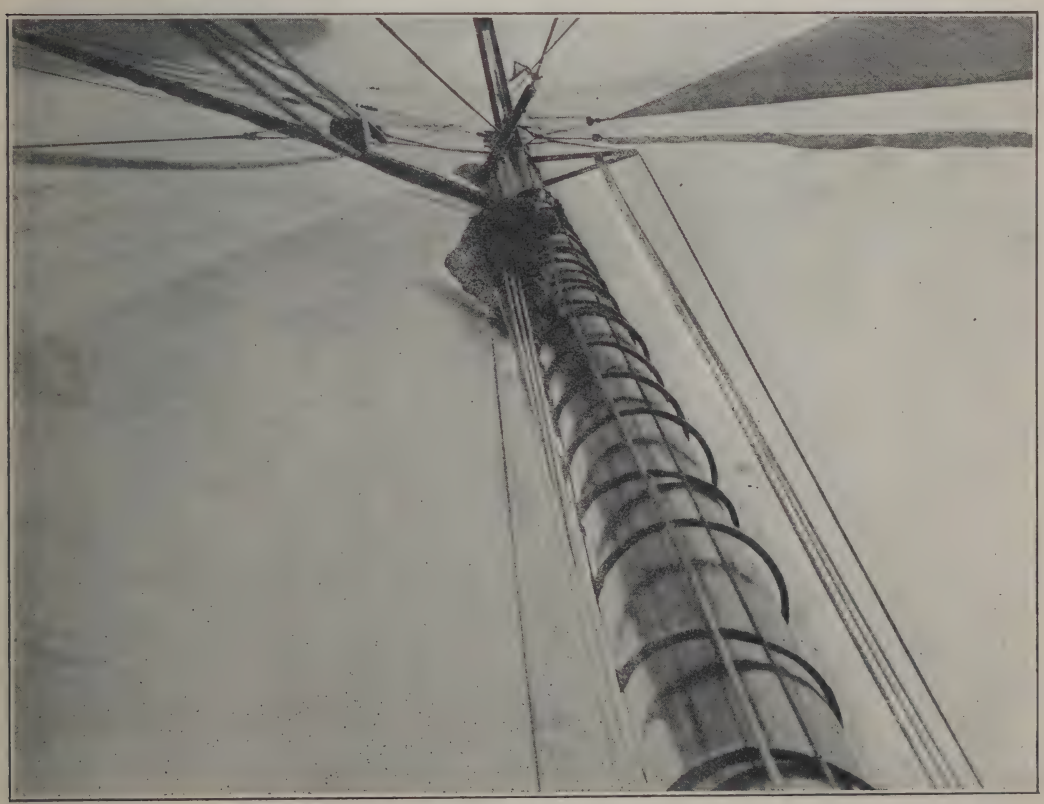
power is generally obtained by a jib-sail, which is stretched from a projecting bowsprit in front of the boat to a point high up the mainmast. Still further sails can be added to the rig of most yachts, such as a " top-sail," fitted above the mainmast spar, and an additional jib-sail, while occasionally a second or mizzen-mast is provided, carrying its own sail. The sails are cut according to the particular rig adopted.

The object in sailing is, of course, to derive the most driving energy possible from the wind, in the direction of travel, no matter in what direction the wind itself may be blowing. This is done by arranging the position of the sails relatively to the wind by means of the lower spar, or boom, fixed to the mainmast, which carries the lower end of the mainsail. The yacht is then kept on her course

by the use of the rudder, while the angle of the sails is set to catch the maximum advantage from the wind.

In sailing round a circular or triangular course, however, there will be certain stretches over which the yacht is sailing directly into the wind, and then another method of progression must be adopted. This is known as " tacking." If the course is due west, for example, and the wind is blowing from the west, the yacht tacks first to north-west for some distance, and then alters her course by a right angle to south-west, so proceeding in a series of zigzags until the desired point is reached.

The amount of sail must be varied according to the strength of the wind. Freshening winds cause the yacht to heel over, sometimes



UP THE MAST—AN UNUSUAL VIEW FROM THE DECK OF " WHITE HEATHER " AT HARWICH

until the port or starboard rail is awash and the whole craft is canted at an angle of 45 degrees or so. By " reefing " or " furling," the amount of sail carried will then most probably be reduced. In the event of a gale blowing up, all sail must be taken in, and the yacht drifts before the wind, or " lies to," as it is called, making for shelter with as much speed as possible. A sailing yacht is undoubtedly a fair-weather craft, and is seen at her best under a blue sky, before a spanking breeze, when she is one of the prettiest vessels afloat.

WELL UNDER WAY—A RACE FOR BIG YACHTS AT HARWICH

A tremendous amount of experience and skill is needed in successful yacht racing, and a race between large yachts is well worth watching. If the start is arranged to be, say, at eleven o'clock, a gun is fired five minutes earlier for each yachtsman to prepare. During the next five minutes he "jockeys," or sails about inside the starting line

in any way that he thinks best in order to cross the line as quickly as possible the moment the starting gun is fired.

The course is perhaps arranged in the form of a square, marked out by buoys or mark-boats, with the starting and finishing point midway along one of its sides. If the wind is at right angles to the first leg of the course, the yacht is "reaching on the port tack" until she gets to the turn, when for the next leg she has to "run" before the wind. For greater assistance here the balloon sail, or "spinnaker," is set, but it must be taken in before the next turn is negotiated. The turns themselves are exciting happenings on board, the crew having to duck as the boom swings over the deck and out on to the opposite side. It is an easy matter to get an unexpected ducking by being swept overboard in this way.

BRITAIN'S LATEST CHALLENGER FOR THE AMERICA CUP—SIR THOMAS LIPTON'S "SHAMROCK V"

On the next leg of the course—the side of the square opposite

ALL TOGETHER—HOISTING THE MAINSAIL

to the starting and finishing line—the yacht is " reaching on the starboard tack," and then, after rounding the third turn, there comes the leg of the course dead into the wind. This is the greatest test of the ability of both yacht and yachtsmen. Sheets are hauled very close, and long or short tacks, as discretion may decide, are made, until at last the fourth mark is rounded. On the final half-leg of the course, " reaching on the port tack " is the order of the going again, until the line is crossed, and when the winning yacht completes the course the gun announces her success to all the spectators.

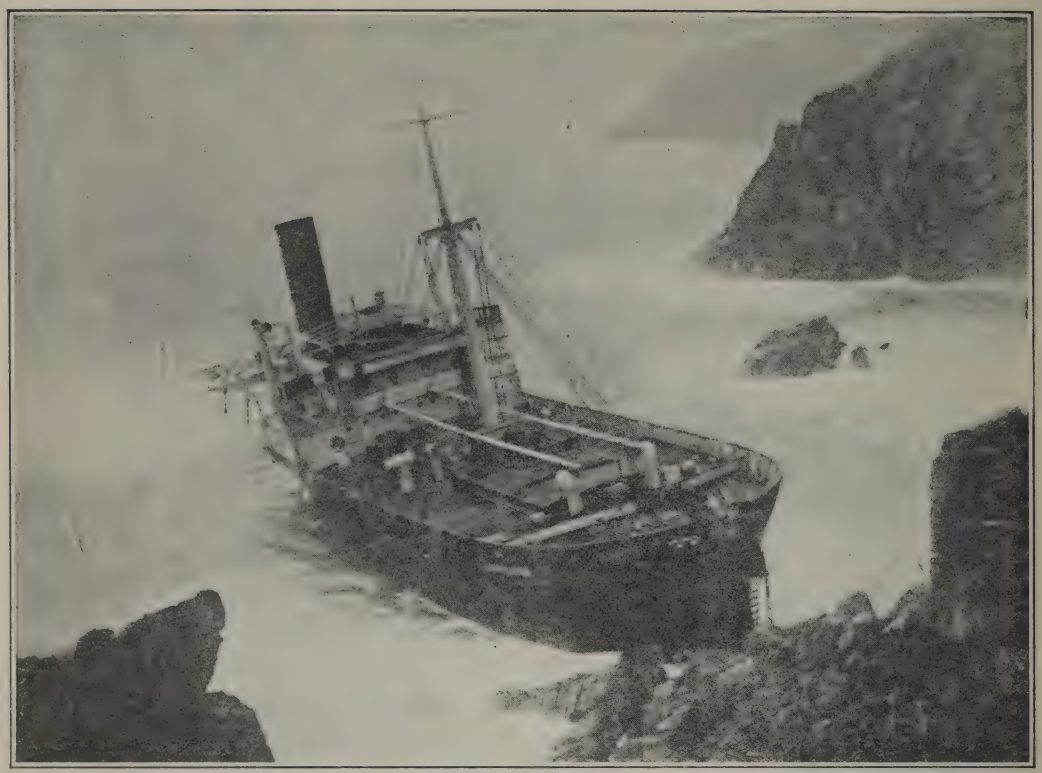
Larger yachts may sail twice round a course of 20 miles, making a total of 40 miles for the race, but the smaller craft are usually confined to a distance of six to eight miles. At times big yachts have raced right across the Atlantic. The most notable of these races was probably that held in 1905, when eleven yachts sailed from Sandy Hook to

THE END OF THE RACE

Land's End, the American three-masted schooner *Atlantic* completing the course of 3,013 miles in the record time of 12 days 4 hours.

The most famous sailing yacht in the world is probably His Majesty the King's *Britannia*, which in her honoured life of nearly 40 years has won more prizes than any other yacht afloat. From 1893 to 1897 she started in 219 races and won 122 first and 16 second prizes ; then in 1920 she took on a fresh lease of life, and in 179 races during the eight summers following gained 47 more first and 48 second places.

Of yacht races the most noted, of course, is that which is held at intervals for the America Cup, a coveted trophy that Sir Thomas Lipton has been seeking for 30 years past to regain for Great Britain. He has built in succession five *Shamrocks* since 1901, but the American yachts *Columbia*, *Reliance* and *Resolute* have up till now just had the better of him. We can only hope that good luck will at last attend the continued efforts of this gallant sportsman !



A Total Loss—The "Cairnavon" on the Rocks near Aberdeen

WRECKS AND SALVAGE

[*All photographs by Sport & General, except as otherwise noted*]

WE are all of us familiar enough with the expression "those in peril on the sea," though perhaps we have seldom stopped to consider what those various perils are. There is, first of all, that of "foundering"—due, perhaps, to the weather-worn structure of an old ship springing leaks with which the pumps are unable to cope, or to unmanageability in a heavy sea by reason of a lost or damaged rudder, or to shifted cargo, or other causes. This is a peril of the high seas, and the greater in that the vessel concerned may be miles away from land, or from any other ship able to respond to signals of distress. Another peril of the ocean, strangely enough, is that of

fire, arising, possibly, from " spontaneous combustion " of an inflammable cargo, and, despite the infinity of water ready to hand, most difficult to get at and to extinguish in the confined space of the hold.

Then there are perils of the coasts—perils of shoals and of reefs, on which a vessel may strand, holding her fast in a rough sea, where she is rapidly pounded to pieces by great waves, or tearing a hole in her bottom and so causing her to founder. Coastal risks are greatly increased in foggy weather, when also the risk of collision, especially in busy waterways like the English Channel, is by no means negligible. But with every fresh scientific development applied to the construction and navigation of ships these perils of the sea become less and less to be feared. The vast majority of voyages to-day, indeed, so far from being the perilous adventures that they were in the earliest

With a Broken Back—The " Porthcawl " Aground on Inchcolm Island, Firth of Forth

days of sailing the oceans, are uneventful almost to dullness in their entire freedom from accident or even incident. But, for all that, even in the best-regulated families accidents will sometimes happen.

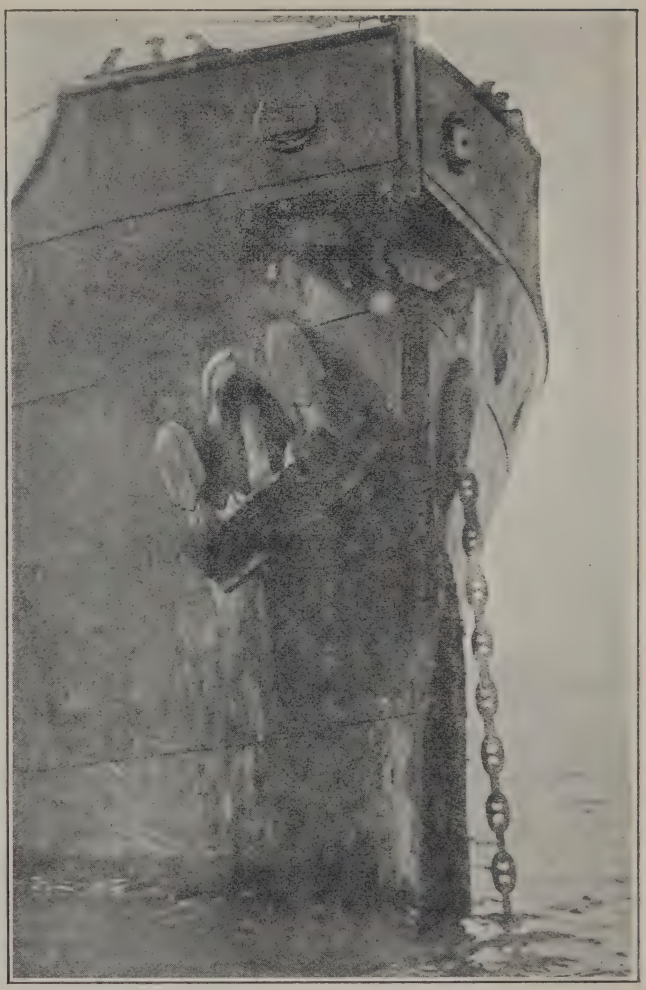
The first concern, in the case of a wreck, is that of saving life. No wireless signal received at sea meets with a more instant response than the insistent " SOS," or " Save our souls ! " as it really means. Every ship in the vicinity will immediately shape its course towards the craft which has sent out the distress signal, and will crowd on every ounce of steam in an endeavour to reach the sinking ship in the minimum of time. The highest speed of 29 knots ever attained by the gallant *Mauretania* was when steaming to help a vessel in distress.

By courtesy] [*Fox*

FIRE AT SEA—THE BURNING OF THE U.S. YACHT " CARNEGIE " AT APIA, SAMOA

But what about our shoal-strewn and rock-bound coasts? This is where the Royal National Lifeboat Institution carries on its magnificent work. Founded in 1824, it boasts the proud record

of having saved no less than 62,000 lives from shipwreck, or an average of 11 per week for more than a century on end. Still more remarkable is the fact that the lifeboat service is absolutely voluntary, and that the £250,000 required to carry on its work each year is raised by voluntary subscriptions. This money—a small sum indeed to pay for so great a work—is used to maintain the 200 lifeboats and lifeboat stations which are dotted round the five thousand miles coastline of the British Isles; to grant rewards to the lifeboatmen for the rescues that they effect or attempt ; and to compensate those who are injured when engaged on this hazardous work, or to provide for their families should they lose their lives.



With Bows Stove In—The "Signe" after a Collision in the Channel

Enormous advances have been made in lifeboat design since a man named Lukin patented his "unimmergible" boat, in which he secured additional buoyancy by a projecting gunwale of cork, with air chambers inside.

By courtesy] [*L.N.E.R.*

LAUNCHING SCARBOROUGH'S MOTOR LIFEBOAT "HERBERT JOY"

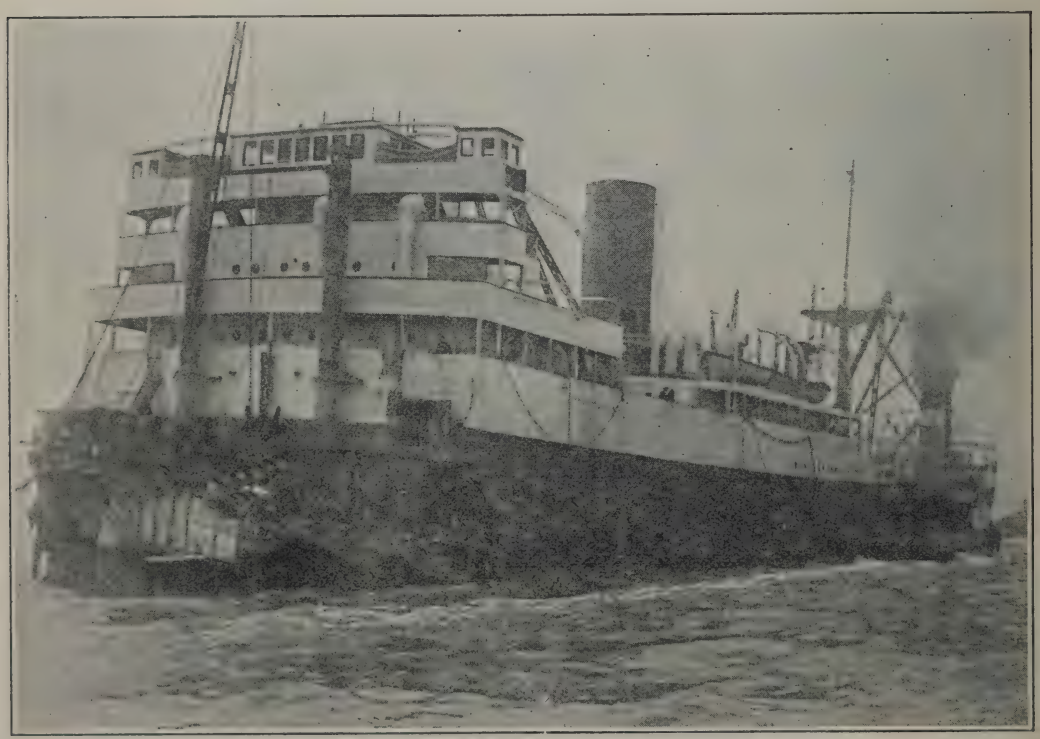
Owing to an exceptionally low tide, the lifeboat is being launched by hand instead of down the slipway

The first true lifeboat, made buoyant by nearly 7 cwt. of cork, and with great curvature of keel, for riding the heavy seas, did splendid service until 1830. It cost £150, whereas the modern lifeboat costs anything from £4,500 to £14,500. The largest type in use to-day is provided with cabins, electric searchlights, line-throwing guns, and oil-sprays for calming heavy seas. Oars are replaced by a 76 h.p. motor engine, so designed as to be capable of running when completely submerged, provided that the air intake is above water. In roughest weather 150 people can be taken on board, in addition to the crew; in calm seas 300 passengers can be carried. Most important of all, the craft is so constructed as to be practically unsinkable. Such has been the advance of a brief century in the magnificent work of life-saving round British coasts.

Mention has just been made of "line-throwing guns." This is the method of rescue often employed when a wreck is in such a position that it is impossible for a boat to come alongside. It is used at coastguard stations and lighthouses as well as from lifeboats. From the gun there is fired a rocket of a special type, which carries a strong cord across the ship in distress. When this has been seized by those on board, a thick rope, attached to the end of the cord, is hauled on board and made fast ; the shore end is supported on a tripod. Along this temporary ropeway there is passed a pulley, with breeches buoy attached, and by means of an endless cord the shipwrecked passengers and crew are hauled, one or two at a time, to safety.

After a Wreck on the Cornish Coast—Life-Saving with the Rocket Apparatus

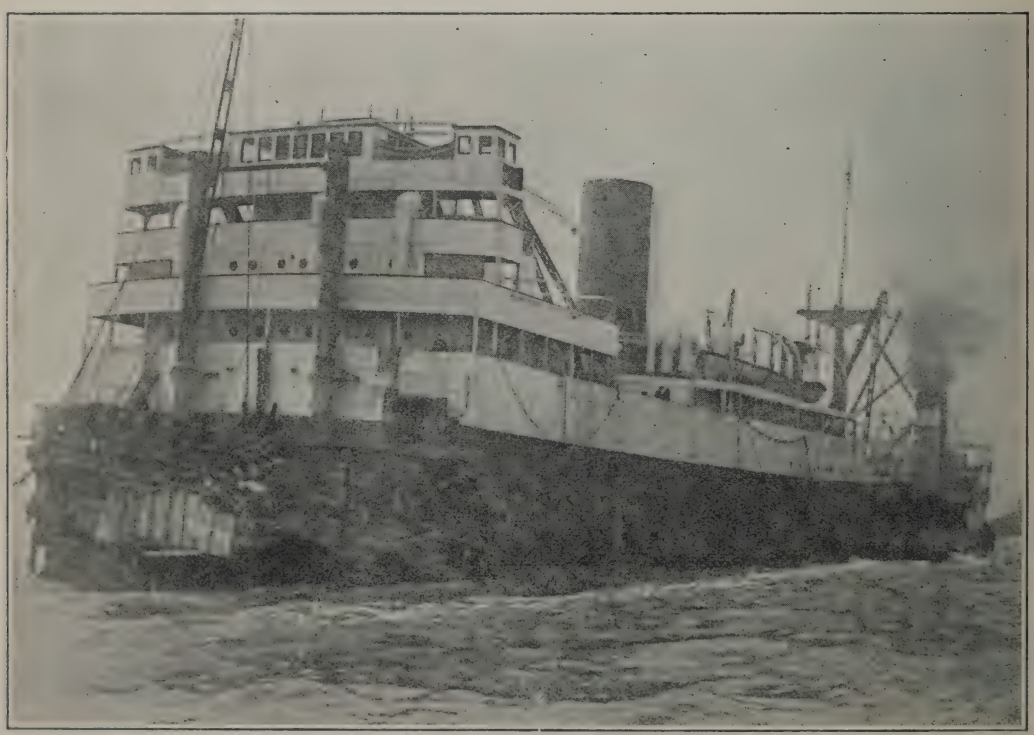
To this valuable work of saving human life at sea there is often added, in these days, that of saving wrecked ships, or " salvage," as it is called. What can be achieved, by remarkable feats of ship surgery, is well illustrated by the two photographs reproduced of the *Lochmonar*, which broke her back when stranded on a sandbank in the River Mersey. The after-part of the vessel was towed across to Belfast, and there the well-known firm of Harland & Wolff built her a new bow and successfully joined the two together, thus giving the *Lochmonar* a new lease of life. This is a reminder of a similar and very striking piece of salvage work accomplished during the war, when the destroyers *Zulu* and *Nubian*, which had both been sunk by submarines, were raised ; the undamaged forepart of one



A Ticklish Feat of Towage—The " Lochmonar," which broke her back in the Mersey, being Towed into Dock

by patching her and then filling her with air by pumping. Divers play an important part in all such work as this, but it has to be remembered that as the pressure of the water increases with its depth it is not possible for divers to work much deeper under water than 150 feet or so; the depth at which salvage operations can be conducted is thus severely limited, and only those vessels can be recovered which have sunk in comparatively shallow water.

the *Lochmonar* a new lease of life. This is a reminder of a similar and very striking piece of salvage work accomplished during the war, when the destroyers *Zulu* and *Nubian*, which had both been sunk by submarines, were raised; the undamaged forepart of one



A Ticklish Feat of Towage—The "Lochmonar," which broke her back in the Mersey, being Towed into Dock

THE "WOODEN WALLS" OF ENGLAND—AN EIGHTEENTH CENTURY MAN-OF-WAR.

Photo] [*Fox*

REPAIRING THE WEST NASH BUOY IN AN OCTOBER GALE

SIGNALS OF THE SEA

THERE is probably not a single reader who is unfamiliar with the way in which the railways maintain the safe working of their trains. It is done by means of signals. In the daytime the signal-arms, which can be seen at a considerable distance, by their position tell the drivers of the locomotives whether or not the line ahead of them is clear. At night, when the arms themselves cannot be seen, the same information is given by coloured spectacles moving in front of the signal lamps, showing red, green or yellow lights.

But it may not have occurred to all of you that in the same way the sea has to be " signalled." The danger which has to be guarded against on the sea is not so much that of one ship coming into collision with another, although such unfortunate accidents as this are not, of course, unknown. But a greater danger is that a ship, by getting

Photo] *[Sport and General*

A Wave-swept Light—Rough Seas at the Longships

out of her course, should run aground, either on a shoal or a beach, or, still worse, on rocks, which might tear through her bottom and put her in immediate peril of sinking.

It is necessary, therefore, for all the sea-coasts throughout the world to be " signalled." The marine signals or signposts provided are of two kinds. For night-time there are lights of all descriptions, ranging from powerful lighthouses, whose lights can be seen from many miles away, to lightships and lighted buoys which mark out the safe channels in coastal areas. In the day-time, though in open sea navigators can set their courses by all the ordinary visible land-marks, the buoys still perform valuable service in marking the channels, for it needs but little water to hide, even in broad daylight, the perils under the surface.

But provision must also be made for misty and foggy weather, when there is no longer any visibility. Sound must now replace sight, and certain buoys, particularly those marking the navigable channels in narrow waterways, are designed to give vocal indications

of various kinds in thick weather. There are, for example, bell buoys, whistling buoys, buoys which make the air hideous with weird wailings and mournful hootings, and so on. No matter how dismal the sound, however, the purpose is friendly and valuable enough.

The earliest permanent lighthouses of which we have any record were erected for the guidance of mariners in various parts of the Ægean Sea, at the Eastern end of the Mediterranean, where, by reason of fogs, rocks and rough seas, navigation is generally difficult. The most famous of these Mediterranean lights, built some two-and-a-half centuries before Christ, was the great " Pharos " of Alexandria, which was four hundred feet high, and its light, always kept burning, was visible forty miles away. In its time it was regarded as one of the wonders of the world ; further, in many countries it has given to their lighthouses, for all time, the name by which they are known. In France, for example, " phare " is the name for a lighthouse.

Lighthouses are of various kinds ; and many different forms of construction are used, according to whether the light is required

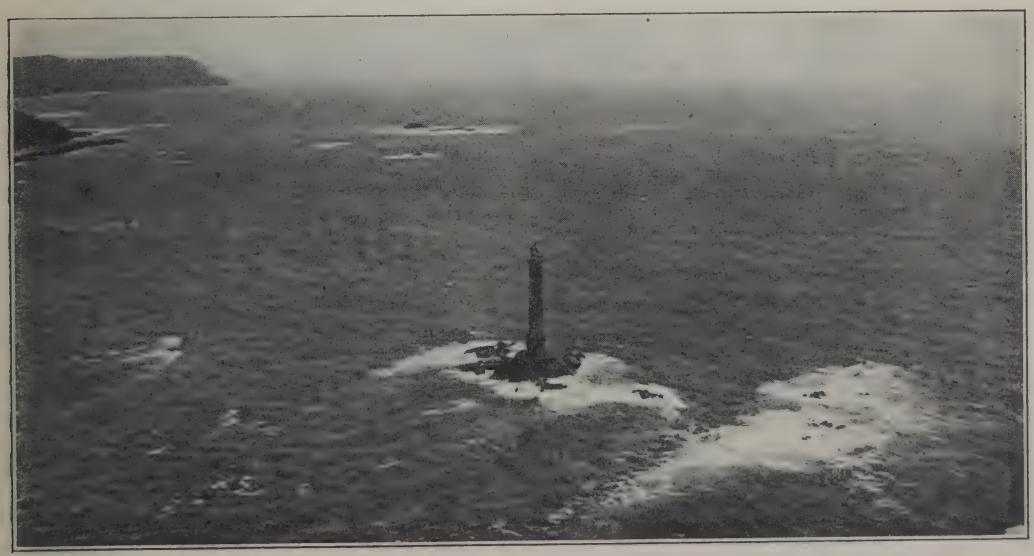


Photo [*Sport and General*

IN THE MIDST OF DANGEROUS ROCKS—A LIGHTHOUSE OFF THE CHANNEL ISLANDS

By courtesy] *[Chance Brothers, Ltd.*

A Modern Unattended Light—The New Heugh Lighthouse, Hartlepool

on land, or at the sea level, perhaps high up on a cliff or other eminence or, yet again, on a rock well out to sea, where the structure itself is exposed to the attacks of the elements in all their fury. It is the last class of lighthouse which is by far the most interesting; it includes many of the most famous lighthouses in the world to-day. The history of some of them has been thrilling indeed.

Off the south coast of Devon, near the entrance to Plymouth Sound, there are found the Eddystone rocks. The reef is uncovered at low water, but at high water the great seas, coming in south-westwards from the Atlantic, cover it completely.

The present Eddystone lighthouse—the fourth erected on these rocks—was designed and built by J. N. Douglass. A massive stone base, consisting of enormous stones dovetailed into one another both vertically and horizontally, and also dovetailed into the solid rock foundation, is no less than 44 feet in diameter, and breaks up the heavy seas, so that nothing worse than spray reaches the height of the lantern. Above the base rises the tapered tower, containing, with

the foundation, over sixty-five thousand cubic feet of masonry, and carrying the light at a height of 133 feet above high water. Begun in 1878, the Eddystone lighthouse of to-day, which cost all but sixty thousand pounds, first showed its light on May 18, 1882.

Another lighthouse which gave enormous difficulties in its erection was that mounted on Bishop's Rock—the westernmost rock of the Scilly Islands—which occupies what is probably the most exposed position of any lighthouse in the world. Begun in 1847, the first structure, an iron trestle erection, was swept away by a fierce gale in February, 1850, just before completion. A tower of granite was then begun in 1851, and its light first shone in 1858. As showing the enormous force of the Atlantic breakers, shortly afterwards one terrific sea, breaking against the lighthouse, carried away the fog-bell, fixed on the lantern gallery at a height of one hundred feet above water level!

The Bishop's Rock lighthouse has been strengthened at different dates, both with internal iron ties and, later, with a casing of granite blocks from

Photo] [*Fox*

THE RELIEF OF LONGSTONE LIGHTHOUSE. THIS WAS THE HOME OF THE HISTORIC GRACE DARLING IN THE FARNE ISLANDS

bottom to top, dovetailed both into each other and into the existing structure. This reconstruction alone cost sixty-five thousand pounds, which sum, added to the original cost, makes up a total of roughly one hundred thousand pounds on this one light alone.

Other famous "wave-swept" lighthouses are the one crowning Bell Rock, in the Firth of Forth, Scotland, 93 feet in height to lantern level ; the Skerryvore, 150 feet high, off the west coast of Scotland, on rocks 12 miles south-west of the Island of Tiree, and the neighbouring Dhu Heartach lighthouse, 14 miles south-west of the Island of Mull—both these immense structures cost over seventy thousand pounds to build—the lighthouse on the greatly exposed Wolf Rock, midway between the Scilly Isles and the Lizard Head, the foundation of which is six feet under water at high tide, and the eighty-thousand-pound Fastnet light, off the south-west coast of Ireland, with its lantern 158 feet above sea level.

Photo] [*Photopress*

A Lonely Home—The Interior of Beachy Head Lighthouse

All these (except the Bell Rock lighthouse) are open to the full fury of the tremendous Atlantic seas. Dhu Heartach is notable, in particular, for having lost, during its construction, fourteen dovetailed stones, each of

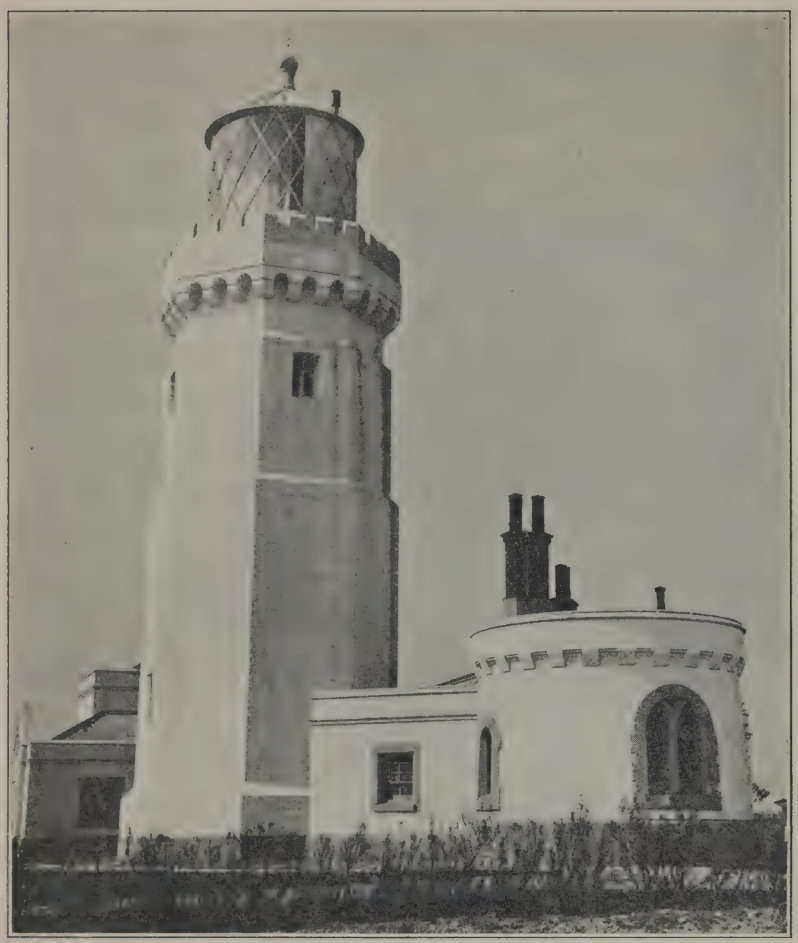
Photo] *[Fox*

A Hazardous Journey—Relieving the Wolf Rock Lighthouse by Life-line

two tons weight, which were washed away by terrific seas from a level 37 feet above high water mark! One of the highest lighthouses in the world is the French Ile Vierge, near Cap Finistère in Brittany, whose lantern towers 247 feet above the rock on which it is founded.

It is next of interest to us to see something of the life of those who, in conditions of exceptional loneliness, are responsible for attending to the lights of these signposts of the sea. For the interiors of these vast colums of stone are hollow. Above the bottom one-quarter of the lighthouse, which is of solid masonry, rooms are provided, in " storeys " one above another, encased by enormously thick walls. The lowest " floor " is usually occupied by a water-tank; then comes the entrance room, and above that, in succession, a store-room, oil-rooms, a living-room, a bedroom, another living-room or store-room, the service room, and lastly the metal structure of the lantern itself.

Three or four lighthouse keepers usually " man " the lighthouse, and when the end of their spell of duty arrives, after a week or a fortnight, arrangements are made to relieve them by sending out a fresh



Photo] *[Sport and General*

ST. CATHERINE'S POINT LIGHTHOUSE
THIS IS ONE OF THE MOST POWERFUL LIGHTS IN THE WORLD

"crew" from the mainland. But it is not always possible to relieve some of the wave-swept lighthouses at the appointed time. For when storms are prevalent, it is sometimes impossible to get anywhere near them for days and days together, or even to get any fresh food to the occupants. At some lighthouses, indeed, such as that on the Wolf Rock, even in the best weather conditions it is generally necessary to swing the men between the relief boat and the lighthouse by means of a breeches buoy. One recent scientific development is valued enormously by these lonely lighthouse-keepers. It is broadcasting, which now enables them, by their wireless receivers, to have unseen "company" during their long spells of duty.

It is, of course, only a small proportion of the lighthouses which are out at sea on these exposed rocks. Many are securely built on

important headlands, such as those on St. Catherine's Point, in the Isle of Wight, or on the Lizard Head, where the lighthouse-keepers can live comfortably in cottages close by. The most important and the most powerful of these lights are what are known on the sea as "landfall" lights; they are the last to be seen as a ship sets out on a long voyage, and the first to be eagerly looked for as land is neared.

This brings us to the lights themselves, which are obviously the most important part of the lighthouse. Even down to the beginning of the nineteenth century braziers containing wood or coal fires served to make the necessary illumination. Then Smeaton introduced candles in 1759, in the Eddystone lighthouse, and soon after attempts were made to increase the brightness of their beams by means of curved reflectors of polished metal placed behind the light. The next development was the introduction of lenses in front of the light —like the " bull's eye " of a lantern—but the greatest forward step was taken when a Frenchman, named Fresnel, devised in 1822 the special form of "dioptric" lens which still forms the basis on which lighthouse opticians work. The combination of reflecting prisms and dioptric lenses used in a modern lighthouse is extremely complicated, as you will realise by looking at the remarkable illustration on the next page.

Coal fires and candles have long since given place to better methods of illumination. Lighthouses at sea have still to rely chiefly on oil. But the accessible lighthouses on land to-day employ many brighter illuminants, particularly acetylene gas and electricity. In consequence it is now possible to leave many of these lights unattended, and when it is mentioned that the cost of manning and maintaining a rock lighthouse with four keepers is anything from £1,200 to £1,300 a a year, and a shore lighthouse about £800 a year, you will realise what a saving is effected when the lighthouse is thus designed to look after itself.

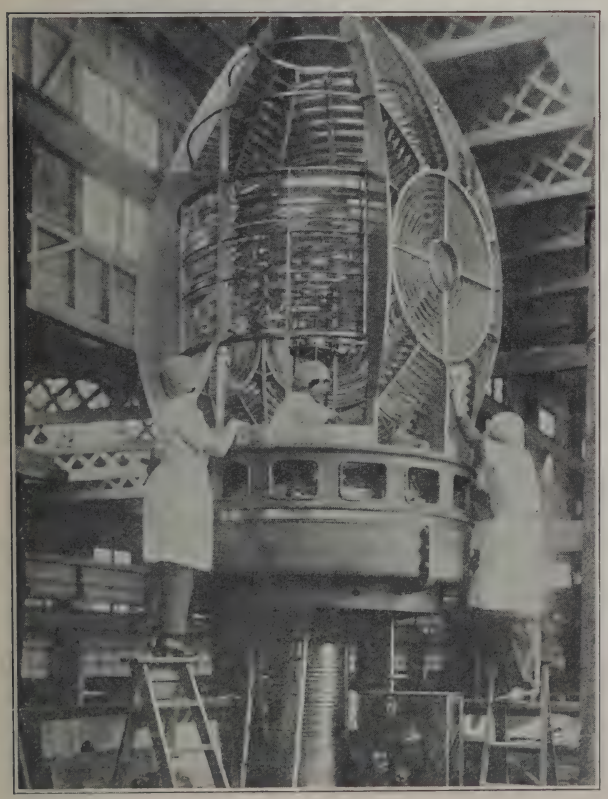
By courtesy] [*Chance Brothers, Ltd.*

A Fine Piece of Craftsmanship

The Lenses and Reflecting Prisms for Eclipse Island Light, Western Australia

For working these self-operated lighthouses some marvellous machinery has been devised. Automatically at sunset the lights are switched on, and at sunrise they are switched off. Not only so, but in the new Hartlepool lighthouse shown on page 52 the mechanism includes arrangements for instantly replacing one enormous electric lamp by another should one fail, and, in the event of the current supply failing, for switching in a stand-by petrol-electric generating set instead—and all without any human help!

You will have noticed that very few lighthouses give a "fixed" light, but that most of them "flash" regularly. These flashes are sometimes at perfectly even intervals, and at other times at irregular intervals, in the form of a code; it is by the way in which they flash that distinction is now made between one lighthouse and another, and the seaman is able, by recognising the particular flash, to check exactly where he is.



By courtesy] [*Chance Brothers, Ltd.*

CLEANING AND POLISHING A LIGHTHOUSE LANTERN

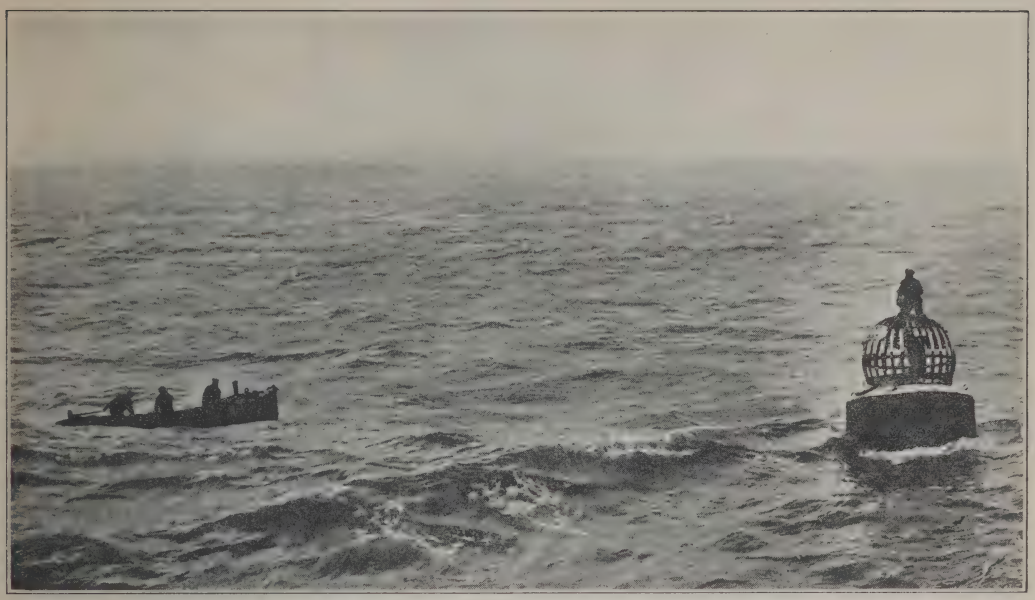
This flashing calls for the provision of further complicated apparatus. Sometimes the light itself, with lenses and reflectors, is made to revolve; in other cases the flash is produced by screens which revolve round the light. A coloured light, alternating with a white light—as the red and white

Photo] *[Sport and General*

THE YACHT "CAMBRIA" ROUNDING THE "CORK" LIGHTSHIP OFF HARWICH

of the Wolf Rock lighthouse—is employed at times, but is not favoured in the case of the important lights, as the use of colour cuts off part of the light; that is to say, without very careful correction, the white light is seen much more clearly than the coloured light.

There are certain locations where lighthouses are needed, but where it is difficult to build them. Of these the most important are sand-banks, either in wide river estuaries, or, like the Goodwin Sands, in the open sea. Where possible, lighthouses are erected, generally by driving screw piles down deeply into the sand, and then building a timber or steel lighthouse structure on them. But the more general method, of which many examples may be found off our East Coast, is to carry the light to sea on a floating vessel—a lightship—specially designed for the purpose, and securely to anchor it in the required position. The first such light-vessel in British waters was anchored at the Nore in 1732.



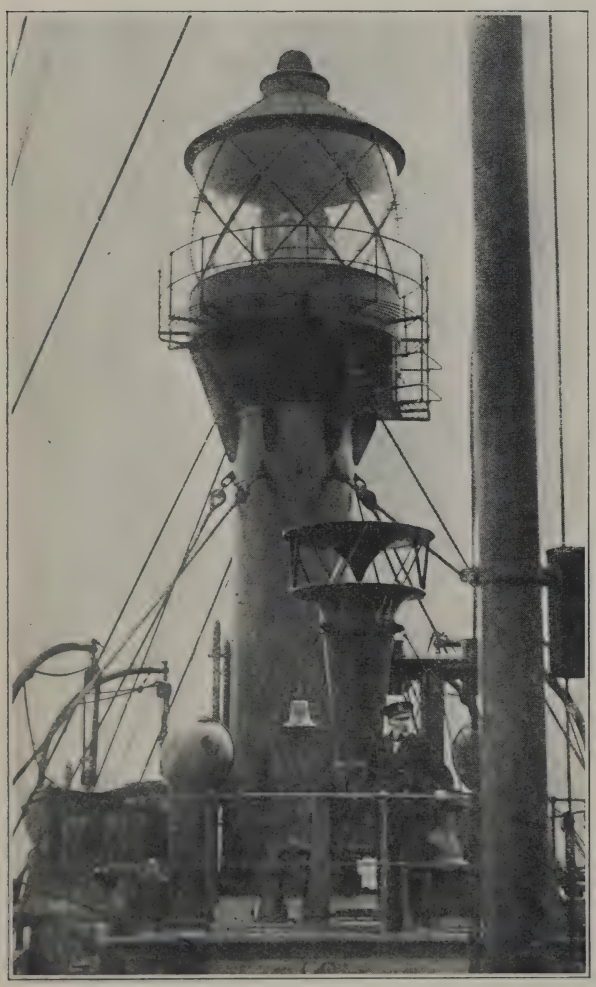
Photo] [*Fox*

ROUGH WORK—GOING TO THE REPAIR OF A BUOY IN THE BRISTOL CHANNEL

A lightship has usually a length of 80 to 115 feet and a displacement of 200 to 500 tons, and modern examples, especially those of the United States, are arranged with their own propelling machinery; others have to be taken to their stations by tugs. As the lightship pitches and rolls with the sea, arrangements are made in modern lightship installations to balance the light itself, so that it always throws its beams in a horizontal direction. Manning a lightship is, perhaps, a task even more trying than that of manning an exposed rock lighthouse, as to the perpetual loneliness there is added the discomfort of perpetual motion! There is also, in foggy weather particularly, the by no means remote danger on a lightship of getting run down by a ship which has lost her way.

Mention must also be made of the many thousands of buoys which, by day and night, mark the limits of channels, the position of sunken rocks or other dangers to navigation, the location of telegraph cables, and so on. In the day-time buoys, which are hollow and securely

anchored down to the sea-bed, are distinguished by the shape of that part of them which is above water, sometimes conical, sometimes flat-topped, sometimes round, and sometimes showing only a spar or mast ; colours, in addition, are used for distinguishing purposes. Conical buoys are always used to mark the " starboard," or right side of a channel, and flat-topped, or " can " buoys, the " port," or left-hand side.



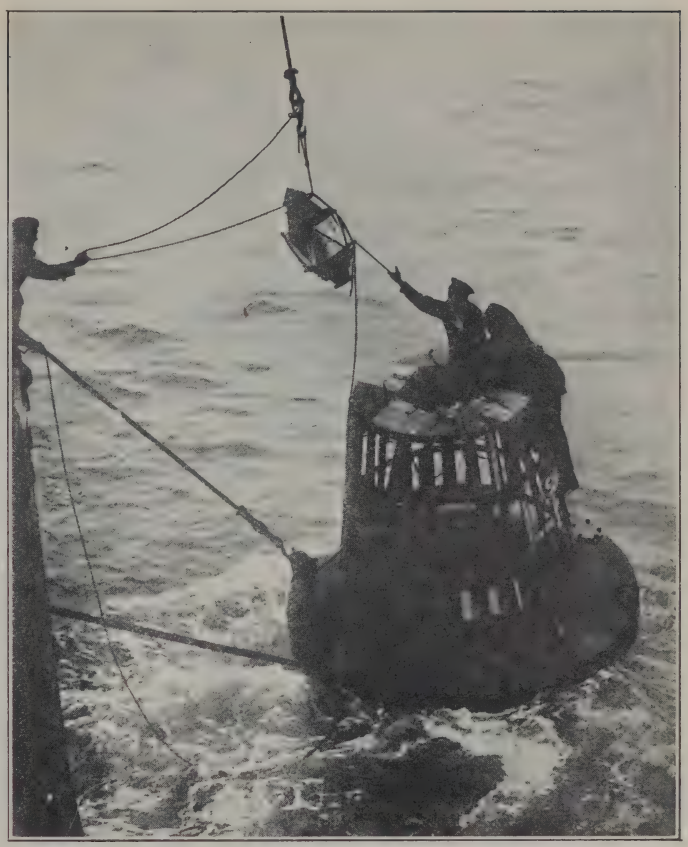
Photo] [*Photopress*

ABOARD A LIGHTSHIP

At night many of the buoys are lighted, and, like the lighthouses, are arranged to flash in various ways, as well as to show different colours. Busy waterways like the Solent or the Spithead, for example, at nighttime show an extraordinary variety of lights, white, green and red, some fixed and some flashing, at different levels—according to whether they are displayed by lighthouses or buoys—and you will well understand why the skill of a local pilot is necessary in order that your ship may find her way safely through such a maze. The lighted buoys, which are mostly fed by oil-gas or acetylene gas, do their duty

for long periods without attention; their compressed gas storage cylinders, indeed, usually have a capacity of three months or longer.

But what about foggy weather, when all these careful arrangements may seem to have so little value? In such conditions sound-signals must be exchanged for light-signals. In many cases buoys are provided with bells or gongs, but the most frequently used signal at lighthouses and on lightships is a horn, worked by compressed air, whose intermittent note finishes with a loud downward "grunt," which is sometimes even better heard than the note of the horn itself. On the high wave-swept lighthouses explosive fog-signals are often employed, like railway detonators; at Bishop's Rock, for example, guncotton charges are exploded at regular intervals by an electric spark, and at Dhu Heartach an automatic "acetylene gun" performs the same duty.



Photo] [*Fox*

A New Lamp for the East Shingles Buoy in the Thames Estuary

Still more modern is such a device as the "fathometer," sometimes known as submarine signalling. By this ingenious appliance

Photo] [*Fox*

GOODBYE—FOR TWO MONTHS

a sound is transmitted by special apparatus attached to the hull of the ship, is "reflected" back from the sea-bed, and is then "received" by another apparatus, the time taken by this sound to travel on its return journey automatically indicating the depth of water, and so helping in the location of the ship. Then there are the various kinds of wireless signals sent out in foggy weather, "wireless beacons," "rotating beams," and other types of apparatus described in the chapter on "The Art of Navigation." But as yet wireless fog-signalling and position-finding are only in their infancy. When this new form of sea-signalling is fully developed it may well prove to be the most valuable aid to navigation, whether by day or night, or in thick as well as clear weather, that science has yet devised.

By courtesy] [*Wm. Watkins, Ltd., Tug Proprs.*

HANDYMEN OF THE PORTS AND HARBOURS A TUG AT WORK.

By courtesy] [*Swan, Hunter, Wigham Richardson*

On the High Seas—A Modern Liner

LIFE AT SEA

A MODERN liner may justly be described as a town afloat. Each of the world's biggest ocean leviathans has accommodation for roughly seven hundred and fifty first-class passengers, six hundred second-class and from one thousand five hundred to two thousand third-class, making a total of over three thousand persons. To this enormous number must be added the crew, numbering, say, eight hundred more, part of whom are occupied in attending to the passengers' wants, like the staff of a gigantic hotel, while the remainder are concerned with the propulsion and the navigation of the ship. The total " population " of a liner of between fifty thousand and sixty thousand tons is, therefore, very little if at all short of four thousand people. It is the purpose of this chapter to tell you some-

By courtesy] *[French Line*

GOLF AT SEA—THE SUN DECK OF THE "ILE DE FRANCE"

thing of the way in which they all occupy their time.

The lot of the passengers is a happy one. Many of them are travelling for reasons of business or necessity. Others, and especially on the longer voyages, may be seeking health and recreation. But with the vast majority the time at sea is one of idleness, to be spent in any way that fancy may dictate, and the shipping companies spare no effort in providing every possible diversion that may serve to increase the pleasure of the voyage. In the evening concerts and dances are organised; in the daytime deck sports of all kinds are

carried on, and while away many a jolly hour on long cruises. Many deck games can be indulged in nowadays, too, such as quoits, shuffle-board, and even a species of golf, as you may see in the picture on page 66.

These are not the only ways in which passengers keep fit. There is no stint of exercise for those who desire it. Three turns round the deck of a nine-hundred-foot ship of to-day provide a walk of a mile, and this is a delightful form of recreation on a calm and bright day. Every large liner now carries her own swimming bath, so that swimming exercise may be added to that of walking, at any hour of the day. One of the coloured plates shows the attractive swimming bath of the great White Star liner *Majestic*, which can be filled with one hundred and twenty tons of warm sea water in the brief space of twenty-five minutes, and is always well patronised.

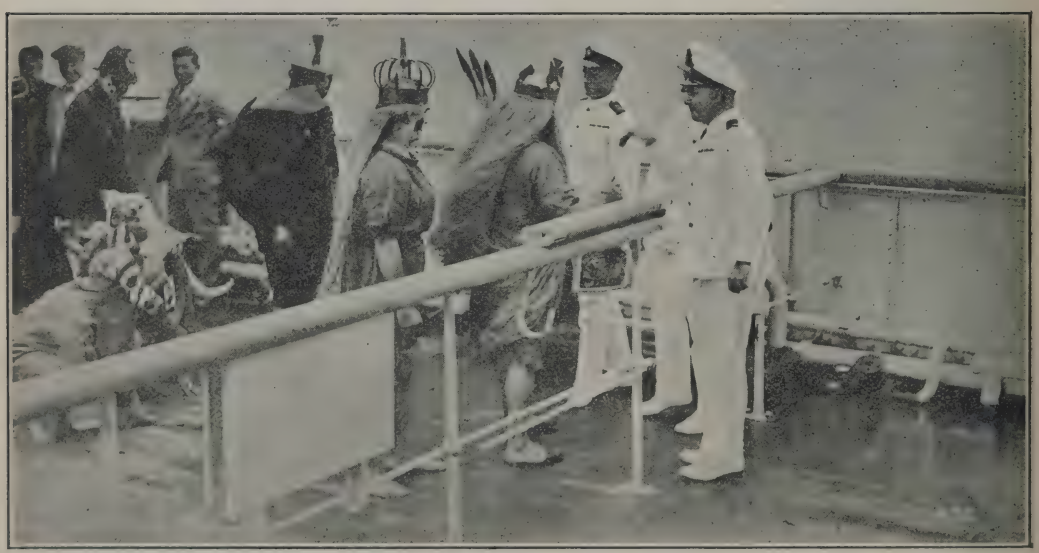
And then more systematic forms of exercise are provided in the liner's gymnasium. This contains modern appliances designed to give exercise in cycling, rowing, ball-punching, weight-lifting and

By courtesy] [*Royal Mail*

PHYSICAL " JERKS " FOR JUNIORS

other kinds of physical " jerks." The " gym " is presided over by a fully qualified instructor, and many a business man, who in a crowded city life has had no time to spare for physical training, makes use of the leisure of the voyage to catch up with that fitness which will make his future work a pleasure. The younger people, too, are looked after by the instructor, as you may see in the jolly picture of boys and girls doing " drill " on the voyage of a Royal Mail liner to South America.

Many hours of the time are passed by passengers in reading. Some travellers bring their own literature with them, but for the remainder every liner of any size maintains a large library, and the librarians find but few spare moments. A full supply is carried of the latest illustrated papers, and not only so, but the big ocean greyhounds also publish their own daily newspapers. The world's news is picked up by wireless, and passed to the " printing shop " on board, where linotype machines, similar to those used in printing newspapers on shore, are used to " set up " the matter ready for printing. It was



By courtesy] *[Royal Mail*

" Crossing the Line "—King Neptune Comes on Board

By courtesy] [*Royal Mail*

KING NEPTUNE AND HIS COURT

in the great Cunarder *Aquitania* that the first " Daily Mail Atlantic Edition " saw publication. Tens of thousands of letters and post-cards are also written by passengers on any long voyage and posted at the various ports of call.

Before we leave the passengers, there is one particular diversion which must be mentioned. It takes place only on voyages on which the ship is " Crossing the Line "—that is to say, passing from North to South or South to North across the Equator. How the idea first took shape is wrapped in mystery, but it has now become a time-honoured custom for the court of King Neptune to visit the ship and for any passengers or members of the crew who have not previously crossed " The Line " to go through the ceremony of " initiation."

King Neptune and Queen Aphrodite, accompanied by the "barber," the "barber's mate," a " clerk " in a three-cornered hat, and a " court "

By courtesy] *[Royal Mail*

KING NEPTUNE'S BARBER AT WORK

consisting of desperado-looking "policemen," "mermaids" and "bears" which make the air hideous with their ferocious growling, come solemnly on board as "The Line" is crossed and are received by the captain, from whom King Neptune immediately asks in stentorian tones the name of the ship. The visitors are all, of course, passengers or members of the crew who have been initiated previously, and are now disguised in the most weird and wonderful costumes.

A move is made for the aft well-deck, where the centre of attraction is a large open-air bath, made of canvas rigged up and filled with sea-water. King Neptune and his court then take their places on a staging alongside the bath, overlooked by passengers crowded on every vantage-point. The bears advance into the bath, and the barber and his mate stand on the staging above it with a chair or box between them on which the unfortunate victims are to sit. A murderous-looking razor about two feet long, a gigantic paint-brush, a comb with enormous teeth, a pail full of soap-suds and a large tin of "South Sea" dough pills comprise their "equipment."

One by one those who seek initiation—it is not compulsory, of course, but few passengers, at least among the men, want to miss the

fun—appear before King Neptune's " throne," and are promptly handed over to the barber and his able assistant. Each victim has one of the doughy pills thrust into his mouth, and then, after his head has been slopped all over with the huge paint-brush, by the barber's mate, is attacked by the barber with the razor—which is, need it be said, only a wooden imitation, for all its terrible appearance—and the comb. The final stage is when the barber deftly tips his victim over backwards into the bath, where he is promptly pounced upon by the bears and is mercilessly ducked. Ladies receive rather more gentle treatment, and one ducking in this case is usually regarded as satisfying the demands of King Neptune. The visit of King Neptune and his court is always a tremendously hilarious affair. On his first voyage across " The Line " the Prince of Wales was duly initiated, and on a later journey to South Africa in the *Kenilworth Castle* he officiated most ably as the barber !

So much for the passengers. Theirs is a care-free life, but not so that of the crew, whose work goes on without intermission. It begins, indeed, before the vessel sails, and continues after the last passenger has disembarked. Some of the heaviest work takes place during the " turn-round "—that is,

By courtesy] [*Royal Mail*

INTO THE ARMS OF THE " BEARS "

between arrival in port and setting sail on the next voyage. A modern liner, worth perhaps three millions sterling of money, is only earning dividends for her owners when carrying passengers across the sea, and idle time must therefore be reduced to the very minimum. Heavy dock and harbour charges continue every day that the ship is in port, and must also be paid out of what she earns while on the high seas. Thus the great Transatlantic liners, which spend some five or six days at sea, generally turn round for the next voyage, after having taken on board all necessary stores for a double journey, in not more than four or five days in port ; at the American end of the voyage the turn-round is accomplished in two days.

The crew of the ship is divided into three parts. The " deck " is responsible for the navigation ; the engineers have charge of the motive power, of whatever kind it may be ; and the stewards are the " hotel " side of the *personnel*, looking after the comfort of the passengers. There are also certain smaller but very important departments. The Purser's department, for example, deals with all the complicated clerical work connected with the running of a great liner and with administration generally. Then there is that most necessary asset to the health of the ship—the surgeon, with his department—and another necessity, in these progressive days, is the wireless telegraph department.

Over the whole ship the captain is in supreme command. His position is one of such distinction that not a few of the captains of Britain's greatest liners have received from the King the honour of knighthood. At the same time his responsibility is very great. Sometimes in thick weather or at other times of difficulty he may be on the bridge continuously for forty-eight hours or more at a stretch. In the ordinary course, however, the Captain in command of a large liner does not have to take part in any definite scheme of " watches," as do the officers under him. But he may always be found on the

By courtesy] [*Cunard Line*

A Night Thrill at Sea—Lowering a Boat from the "Berengaria"

By courtesy] [*Cunard Line*

EMERGENCY BOAT DRILL AT NIGHT ON THE "BERENGARIA"

bridge when the liner is nearing land or making or leaving port. He is not only entrusted with the safety of his ship, but is expected to be acquainted, in a general way, with all that is happening on board. In the biggest liners of to-day it is becoming a customary practice — for the introduction of which the Cunard Company was responsible—to appoint a "Staff Captain" immediately in charge of the ship's staff and responsible for discipline, but under the command, of course, of the Captain himself.

Under the Captain there come the Chief Officer of the ship; and then, in turn, the First and Junior First Officers, the Senior and Junior Second Officers and the Senior and Junior Third Officers. All of them have to be men of the highest experience, and on the super-liners of to-day even a Junior Third Officer must be in possession of a master's certificate before he can be appointed. When the ship is entering or leaving port these officers have allotted to them various "stations," in different parts of the ship, which also they take up in order to be prepared for any emergency. The Chief Officer and the First Officer supervise the safe stowage of all the cargo and the taking

on board of fuel and water, and are responsible for signing on the crew in their own department and mapping out the stations of the crew in the event of collision or fire.

This matter of stations is one of vital importance. In proportion to the thousands and thousands of miles covered by liners at sea, accidents are few and far between, but provision must be made for every possible happening. Each passenger, too, has indicated to him where his boat station is and the quickest way to get to it from his cabin ; and each cabin has in it sufficient lifebelts for all its occupants. Soon after leaving port " boat station drill " takes place, at which every passenger must be present, and instruction is given as to how to fix lifebelts in position. Sometimes emergency boat drill takes place at night, as you may see in the picture on page 74. When the weather is suitable the boats are often swung out at sea and lowered part of the way to the water, and in port all the boats are lowered to give the crew exercise in pulling and sailing. Another kind of emergency drill, regularly carried out, is fire drill, when hose-pipes are run out and hydrants are tested, usually, for practice sake, in the most awkward part of the ship.

In charge of the Second Officer are all the appliances connected with the navigation of the ship, such as compasses, chronometers, charts, sounding appliances, signal controls, flags, fire and life-saving appliances, distress signals, and so on. Compasses are checked two or three times during each watch, and the position of the ship is taken at least once every four hours, according to the time of day or night by the sun, the planets or the stars.

Several references have already been made to " watches," or turns of duty, on board ship. One senior and one junior officer are always on duty together on the bridge. Each watch lasts for four hours, and each officer undertakes two such watches a day, with eight hours' interval between each watch. In entering or leaving port, however,

By courtesy] *[Cunard Line*

THE PURSER'S OFFICE ON S.S. "FRANCONIA"

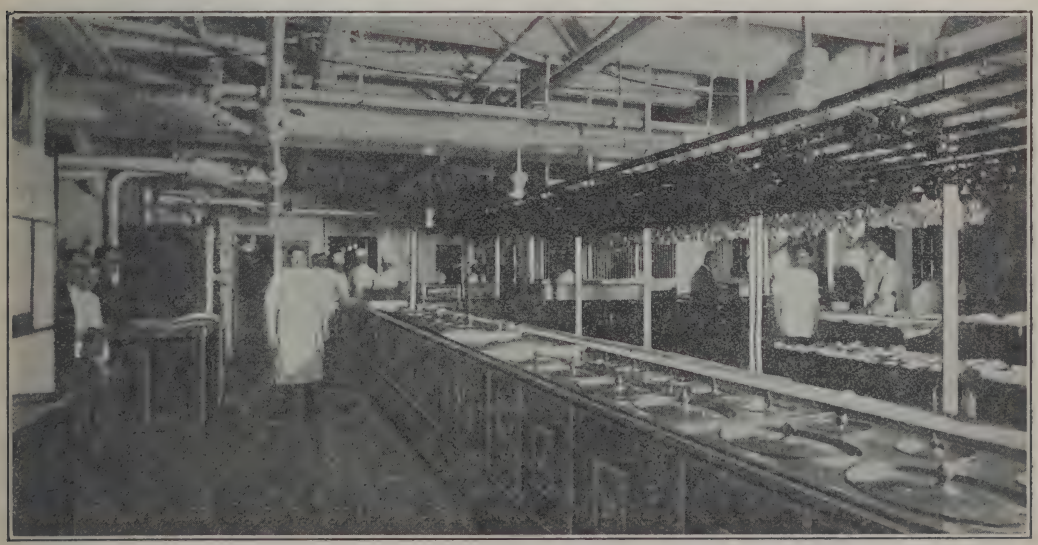
all the officers are on duty, each one with his particular station, as already mentioned.

On a liner of the size of the great *Aquitania* of the Cunard line the deck staff consists of six quartermasters, two masters-at-arms, three boatswains, two lamp trimmers, seventy seamen and four carpenters and joiners. The quartermasters take two-hour turns at steering the ship ; the boatswains are in charge of the deck hands ; the masters-at-arms look after the gangways and the third-class decks ; the lamp trimmers attend to the lamps. Deck hands are largely occupied in keeping the ship clean. All decks are washed down every night, and there is constant work to be done in touching up the paintwork, overhauling lifeboats, and many other useful tasks.

And now a word or two about the Purser and his department. The *Aquitania*, to which reference has just been made, carries a Chief Purser, a Staff Purser, and nine or ten Assistant Pursers. The Chief Purser has to be a man of a thousand-and-one accomplishments. The clerical work carried on in his office alone is enormous.

Passengers' steamer and railway tickets, declaration forms, lading cards and passenger returns ; wages sheets, insurance cards, and discharge books in connection with the crew ; and the most minute detail relating to the cargo ; all have to be attended to during the voyage. But the Chief Purser has many other activities. For example, he is in charge of the ship's music, and, at the other end of the scale, of the " inspectors," who are, in reality, the ship's policemen. These latter, fortunately, have some of the lightest duties on the ship, though they do occasionally get a "case " with which to deal.

Another most important department is that of the Chief Steward. He is responsible for everything connected with the passengers' comfort. First of all, the matter of feeding nearly four thousand hungry people on a modern super-liner is no light task. To cater for the passengers on a ship the size of the *Olympic*, one of whose kitchens is shown below, the Chief Steward has to serve some nine thousand meals daily, apart from enormous quantities of light refreshments. For one trip to America the *Olympic* may take on board fifty



By courtesy] [*White Star Line*

THE KITCHEN OF THE " OLYMPIC "

By courtesy] *[Royal Mail*

THE DINING SALOON OF THE "ALCANTARA"

oxen, fifteen calves, seventy lambs, one hundred and sixty pigs, two hundred sheep, three thousand birds ranging from pigeons to turkeys, and eight thousand quails; one thousand pounds of salmon and fifteen thousand pounds of assorted fresh fish; seventy thousand eggs; one thousand boxes of fresh fruit; three hundred barrels of flour; and so on, *ad infinitum*. Elaborate refrigerating chambers are needed to hold all these vast stores; the *Aquitania's* refrigerating plant has a storage capacity of over eighteen thousand cubic feet and can produce thirty tons of ice a day.

In a liner like this the kitchen staff alone totals at least one hundred, under the Senior Chef—one of the best-paid officials on the ship. There is also the pantry staff, who are in charge of some one hundred thousand pieces of earthenware, china and glass, and twenty-five thousand pieces of silverware. To these must be added butchers, bakers and confectioners; all the bread and pastry used on the ship is cooked on board.

The Chief Bedroom Steward supervises the service in the cabins, for which bedroom stewards and stewardesses are required. Here again some herculean tasks have to be undertaken. Soiled linen on

By courtesy] [*White Star Line*

ON THE UPPER DECK—THE GARDENER OF THE "MAJESTIC" AND HIS GREENHOUSE

one voyage alone of a large Transatlantic liner may amount to one hundred thousand pieces. This has all to be dealt with on arrival in port, but on longer voyages a laundry is established on board for the purpose. Then the Chief Steward controls the librarians, gymnastic instructors, bath and lift attendants—for the latest large liners are all provided with electric lifts between the various decks—and, of all people to have afloat, a gardener! So many plants are now carried on board, in lounges and elsewhere, that they need the expert attention of the last-mentioned gentleman. On the *Majestic* he proudly owns a greenhouse, as you may see above. The Chief Steward's department on the *Aquitania* numbers roughly five hundred men all told.

By courtesy] BELOW THE WATER-LINE [*L.N.E.R.*

A STOKER ON THE S.S. "MALINES"

Last of all, we must

descend to the very lowest part of the ship, well below the water-line, in order to find the engineers at work. The Chief Engineer of a super-liner controls some thirty or more engineer officers, under whom are the stokers—or, in oil-burning liners, the men who attend to the oil-fuel burners—men charged with the greasing and lubrication of the machinery, electricians, plumbers and others numbering perhaps more than one hundred and fifty all told.

One engineer must always be on duty in each boiler-room, to supervise the men working there. Oil-burning has, of course, greatly reduced the labour involved in raising steam at sea. Several of the world's biggest liners could only maintain their speed by a consumption of some nine hundred tons of coal *every day ;* all this had to be transferred by hand into the furnaces of the boilers. To-day, though the same liners may require eight thousand tons of oil to take them across the Atlantic and back, the firing consists in controlling the flow of oil to the furnaces—a task more for the head than the hands. In consequence, though oil-firing is in itself more costly than coal-firing, it has been possible considerably to reduce the engine-room staffs, by way of a balance, after changing from coal to oil. And then, of course, there are the motor-ships, in which, by the use of Diesel engines, steam has been done away with altogether.

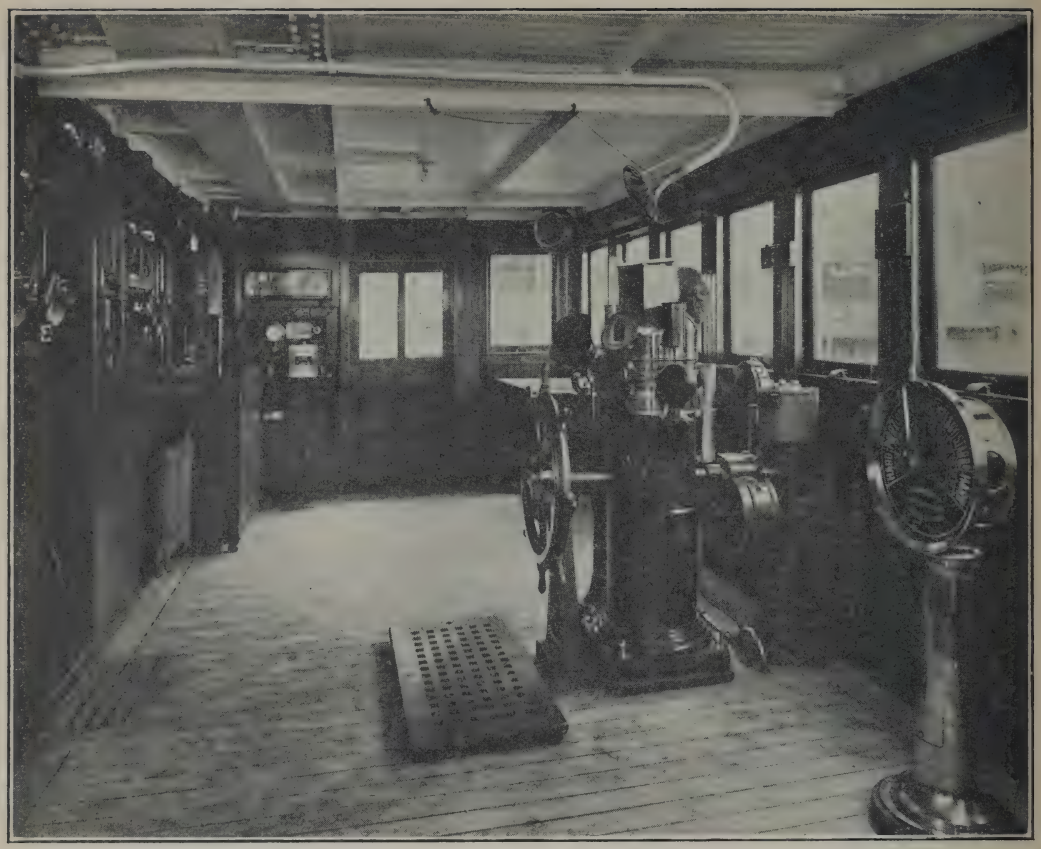
Two or three of the engineers are in continuous attendance at the starting-platform of the engine-room, to which, by the telegraph from the bridge, the Captain's orders are transmitted, and from which the propelling machinery is controlled. Water must be kept at its proper level in the boilers ; the revolutions of the machinery, pressures, temperatures, coal and water consumptions, and many other details, must be measured and recorded ; minor casualties to machinery must be remedied on the spot. The closest watchfulness must be maintained at all times when the vessel is at sea. In rough weather huge waves may cause even the biggest vessels to pitch in

such a way that for a moment or two the propellers are lifted clean out of the water, and this must be guarded against by throttling down the steam supply, to prevent the engines from racing.

Miles of service piping are carried all over the ship for various purposes. On the *Aquitania* seven hundred miles of electric wire and cable are in use, supplying some ten thousand lamps and one hundred and eighty electric motors which perform all kinds of service. Then there is auxiliary machinery of many descriptions, such as cargo derricks, anchor windlass, warping winches, the hydraulic plant for opening and closing the bulkhead doors, kitchen and refrigerating plant, and so on. All these sections are under the charge of special engineers. Like the deck officers, each engineer has normally two four-hour spells of duty a day, with eight hours for rest between each watch.

The various " watches," to which references have been made, are marked by the ringing of the ship's bell—an important operation which takes place at regular intervals. Noonday is sounded by eight strokes on the bell, given in four pairs ; half-past twelve by a single stroke ; one o'clock by a pair of strokes ; half-past one by a pair of strokes and a single stroke following ; and so on up to four o'clock, when " eight bells " are sounded, given in four pairs of strokes. Not more than four strokes on the bell are sounded at any hour during the " dog watches," between four and eight o'clock.

Every morning at sea, at 10-30 a.m., an inspection of the ship throughout is made by the Captain, the Staff-Captain (where one is carried), the Chief Purser, the Doctor and the Chief Steward. More detailed inspections take place when the vessel is in port, as officials representing the owning company then come on board, to see that everything is in perfect order before the next voyage. British shipping companies are jealous of their reputations, and it is no idle boast to say that the majority of travellers at sea, of no matter what nationality, would rather sail under the British flag than any other.



By courtesy] [*Cunard Line*

THE "BRAIN" OF THE SHIP—NAVIGATING BRIDGE, S.S. "FRANCONIA"

Wheel and binnacle in centre; engine-room telegraph to right; watertight compartment control on left of door; telephones to all parts of ship on left-hand side.

THE ART OF NAVIGATION

ON a long voyage a ship may be for days, and even weeks on end, completely out of sight of land. A great ocean like the Atlantic, or the Pacific, is a trackless waste of waters thousands of miles in extent. How, then, does the mariner make sure, not only of finding his way from one port to another, but also of keeping exactly to the shortest course from his starting-point to his destination? It is by the highly skilled art of navigation, or "piloting."

Into and out of the various ports, or along waterways where

navigation is difficult or dangerous, control is taken over by local pilots who are familiar with every detail of navigation in that particular locality. Among the most competent pilots are those maintained directly by the organisation known as " Trinity House," whose pilots are responsible for navigation of the approaches to the most important British ports, such as London and Southampton. These pilots are in all cases qualified ships' officers, who have elected to take up this most responsible duty, and a lengthy and varied experience at sea is called for before the coveted appointment can be obtained.

At certain specified places outside each port the pilot is picked up ; in the case of London, for example, where Trinity House controls the piloting right round from Selsey Bill to Orford Ness, the pilot may come on board at one of the Channel ports, if the ship is calling there ; otherwise, if the vessel is coming up Channel, he is taken on board at Dungeness. So far as navigation is concerned, the ship is now entirely under the pilot's control ; what is more, the captain is liable to a heavy fine if he neglects to take a pilot through such waters as these. When the ship reaches Gravesend, the Dungeness pilot is dropped, and another pilot, familiar with the minutest detail of the navigation of the Thames, comes on board. Yet another pilot is probably needed to dock the ship, or to bring her to the quay. The bigger the ship, so much the greater the pilot's responsibility—and, incidentally, the pilotage fee which has to be paid goes up in proportion—but such is his experience that the little red-and-white flag which flies between the masts when the pilot is in charge is a guarantee that the ship is in safe and competent hands, no matter how difficult the passage.

On the outward journey the pilot similarly controls the ship until the limit of pilotage has been reached, when he is " dropped " into the pilot cutter to return home. The navigator on the ship has now to

By courtesy] *[Royal Mail*

A Striking Coast-Line Near Rio de Janeiro, South America

take over. If his vessel is merely "coasting"—that is, passing along the coast of a country, from port to port, without getting out of sight of land—his steering is based largely on prominent land objects, coupled with the use of charts, and, of course, the compass.

A word needs to be said here about these charts. Every country has its own series of charts for the use of mariners. They are simply sea maps, plotted in very fine detail. In our own country the Admiralty Charts for British vessels number over 2,600 in all, and are designed to meet the needs of British navigators in every part of the world. What is more, they are recognised the whole world over as the finest and most accurate charts available, and are widely used by the ships of other countries as well as our own. Most of the German ships captured during the Great War were found to have British charts on board. These charts, which are prepared by the Hydrographic Department of the Admiralty, first established in 1795, are of various kinds. There are ocean charts, general charts, coast charts, physical charts and harbour plans, and according to the direction of

Photo] *[Sport and General*

A Well-known "Leading Mark"
The Needles Lighthouse, Isle of Wight, at the Entrance to the Solent

the voyages made by any ship, so all the large number of relevant charts must be carried on board.

Coast charts and harbour plans are the most detailed. Harbour plans, in particular, show all the "leading marks" for channels—that is, conspicuous objects which, if kept in line, enable a ship to follow a safe course, clear of shoals, rocks or other dangers—together with the various lighthouses, lightships, buoys and beacons. The character of each light indication is also carefully shown, such as the colour of the light, the way in which it "flashes," the range of visibility, and so on.

Another striking feature of the charts is the way in which they are studded all over with figures. These figures represent "soundings," and give most important information as to the depth of water available at every point, and at different heights of the tide. It is vital, for example, that the mariner shall know of the existence of all reefs, or shoals, which, though unseen, are only just below the surface of the water, and on which, if he were ignorant of their existence, he might run his ship. Part of the routine of navigation consists in taking soundings, to help in verifying the ship's position.

The sinker of the sounding machine brings up from the sea-bed a sample of whatever deposit may lie there, which is a further assistance, as the charts indicate also the nature of the sea-bottom in all shallow waters.

Unfortunately the depth of the sea does not always remain exactly the same. Shoals or sands may shift their positions after exceptional storms. At times, also, there are colossal upheavals of the ocean beds, corresponding to the disastrous earthquakes sometimes experienced on land. History records not a few cases in which new islands have appeared in this way, or by volcanic action, while other islands have disappeared completely from view.

From time to time, therefore, the Admiralty issues "Notices to Mariners," indicating all alterations needed to charts as a result of the latest information to hand. These corrections must then be carefully noted on the ship's charts. In the case of the big passenger

By courtesy] [*Royal Mail*

A Peril to Navigation—Floating Ice

liners, the charts are inspected and corrected before each voyage is made.

The second indispensable and constant standard of reference in the navigation of a ship is the magnetic compass. The ship's compass of to-day consists of a circular " card," mounted on an aluminium frame, and directed from underneath by a system of short and light magnetic needles, never less than two in number, and up to as many as eight. The card, with its aluminium centre, is poised upon a cone made of highly polished sapphire, and the whole is carried in a brass bowl. The latter is called the " binnacle," and completely encloses the compass, the card of which, however, is visible through a glazed opening, and is illuminated at night.

The circumference of the compass card represents the horizon, and is divided, first into four equal parts by the diameters representing North and South, East and West, and then subdivided into four more points —North-West, North-East, South-West and South-East ; eight more divisions— N.N.E., N.N.W., E.N.E., E.S.E., W.N.W., W.S.W., S.S.E. and S.S.W.— and sixteen more subdivisions still make thirty-two points of the compass in all. Around the margin of

A Modern Compass Card

the card is the division of the complete circle into 360 degrees. It is chiefly by the use of the compass that the course of the ship across open sea is shaped.

Photo] *[Sport and General*

NAVIGATORS OF THE FUTURE
H.M.S. TRAINING SHIP "WORCESTER"

The compass needle does not always point exactly to the north. Actually, the "magnetic" north is at some appreciable distance from the actual North Pole. Further, for causes too complicated to explain here, the compass needle generally diverges to the east or west from the "true north," making with the true meridian an angle, which is called the magnetic variation, or "declination"; for this variation carefully calculated allowances must be made. A source of disturbance to the needle, again, is the steel of which the ship is built, for which further allowances must be made. The needle, yet again, is attracted or repelled, in certain parts of the world—such as the coasts of Iceland and Madagascar—by the presence of magnetic rocks on shore. All these matters complicate the work of navigation.

A number of compasses are carried on board, up to as many as six on a modern liner. Of these the most important is the "standard" compass, usually located on top of the wheel-house, or, as the sailors

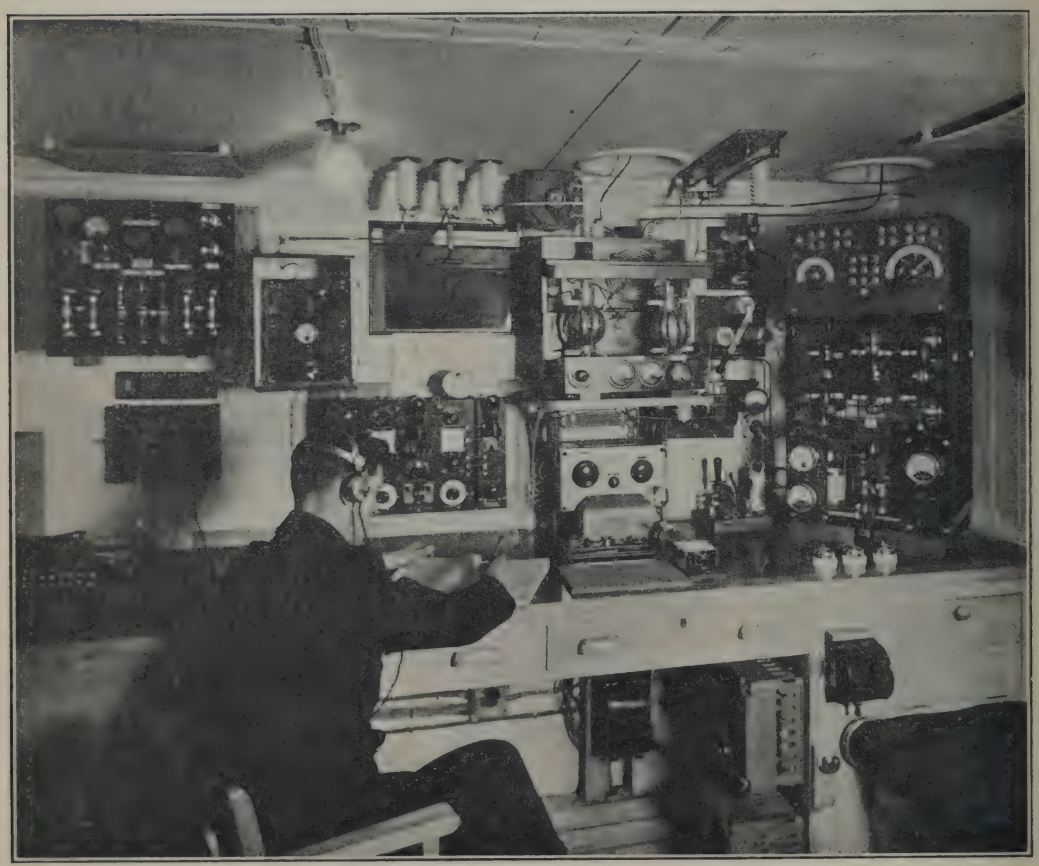
By courtesy] *[Cunard Line*

THE START OF A TRANSATLANTIC VOYAGE
S.S. "BERENGARIA" LEAVING NEW YORK

say, on "Monkey Island." It is placed exactly on the centre-line of the vessel, and in its immediate neighbourhood brass is used as far as possible, instead of steel, for deck fittings, so as to reduce the effects of magnetic attraction to the minimum. This compass is the standard of reference throughout the voyage. In the wheel-house below it is the steering compass, at which the Quartermaster stands while steering the ship. In the binnacle a vertical black line, called "the lubber's line," painted inside the bowl of the compass, corresponds exactly with the direction of the ship's head, and enables the helmsman

to steer a true course. By careful steering, counteracting any deviation that may arise from the effect of the sea or the wind, a skilful Quartermaster will save many miles on a long voyage. Another compass is located on the bridge, in front of the wheel-house, for the use of the officer of the watch.

We now come to the methods adopted by the navigator when out of sight of land. Here he has to bring to his aid the celestial bodies



By courtesy] *[Marconi's Wireless Telegraph Co.*

THE LATEST IN WIRELESS COMMUNICATION AT SEA
THE OPERATOR'S CABIN ON THE ROYAL RESEARCH SHIP "DISCOVERY II"

From left to right: main switchboard, emergency "spark" transmitter, medium and long wave receiver, short wave transmitter (above) and short wave receiver (below), 1½ Kw. valve transmitter for working on 600-800 metres wave lengths.

By courtesy] [*Marconi's Wireless Telegraph Co.*

START POINT LIGHTHOUSE

Equipped with a Marconi Beacon Transmitter, of which the aerial is seen to the left of the lighthouse. The call sign is "GSM," the wave length 1,000 metres and the power 500 watts.

—the sun and stars—instead of terrestrial objects. In view of the considerably greater skill so required than in coasting merely, this oversea navigation came to be known as "proper" piloting, as distinguished from the "common" piloting which has fixed landmarks as its basis.

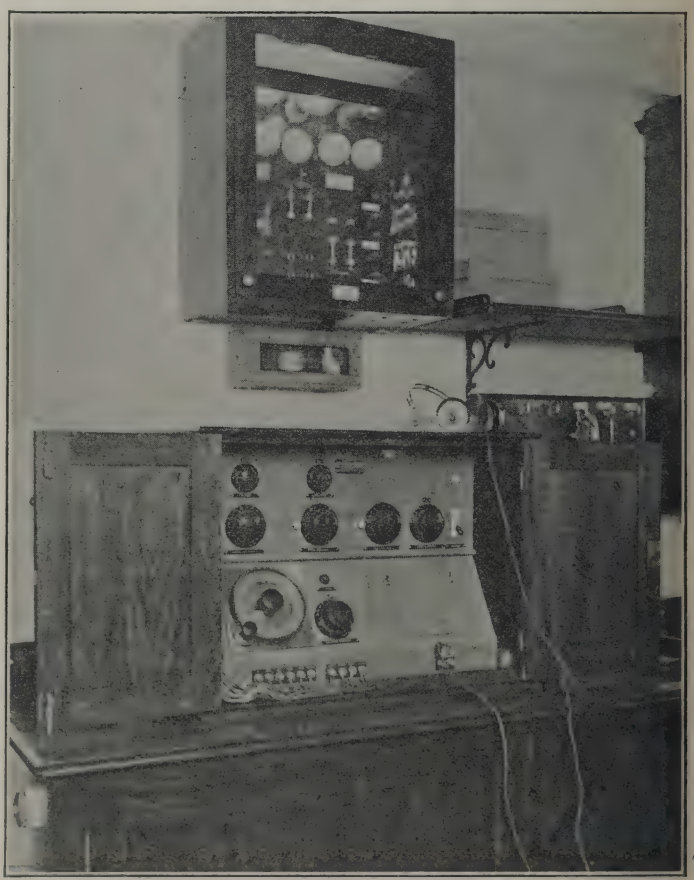
In setting out on a voyage, after the local pilot has left the ship the navigator's first care is to "take a departure." That is to say, by cross-bearings on two or more conspicuous objects still in sight on shore he fixes the position of the vessel on the chart. This forms the initial position for the voyage, and from the latitude and longitude so obtained the course is shaped and the first distance reckoned.

From now onwards a close watch must be kept on the distance covered by the ship. This is measured with very fair accuracy by the "log"—a small screw-shaped appliance which is towed by a specially plaited "log-line," between 350 and 400 feet long. The log revolves a certain number of times in passing through a given distance under water, and not only measures the distance but also the speed of the ship. In modern vessels the log is often duplicated and towed by special fittings from both sides of the bridge. The information obtained is then carried by electrical transmission to dials

located in the chart-room.

And thus, from the course followed by the ship, as set by the compass, and the distance, as measured by the log, there is worked out from day to day, by " dead reckoning," the position of the ship. Dead reckoning makes no allowance, of course, for drift caused by the wind or by currents, nor, again, for possible errors both in the steering and in the navigator's calculations. Further check is possible by means of an instrument called the sextant, which enables observations to be made on the sun or the stars. To the sailor this operation is known as " shooting the sun." But such a check as this is not practicable in cloudy weather, or, still worse, when all visibility is lost in a blanket of fog.

In these days, however, an additional and most valuable check is afforded the navigator by means of wireless communication, which is independent of all weather conditions. Directional wireless enables him to take cross-bearings on two or more wireless stations, and in this way closely to fix his position. It was by the remarkable



By courtesy] *[Marconi's Wireless Telegraph Co.*

MARCONI DIRECTION FINDER
IN THE CHART-ROOM OF THE ORIENT LINER " ORONTES "

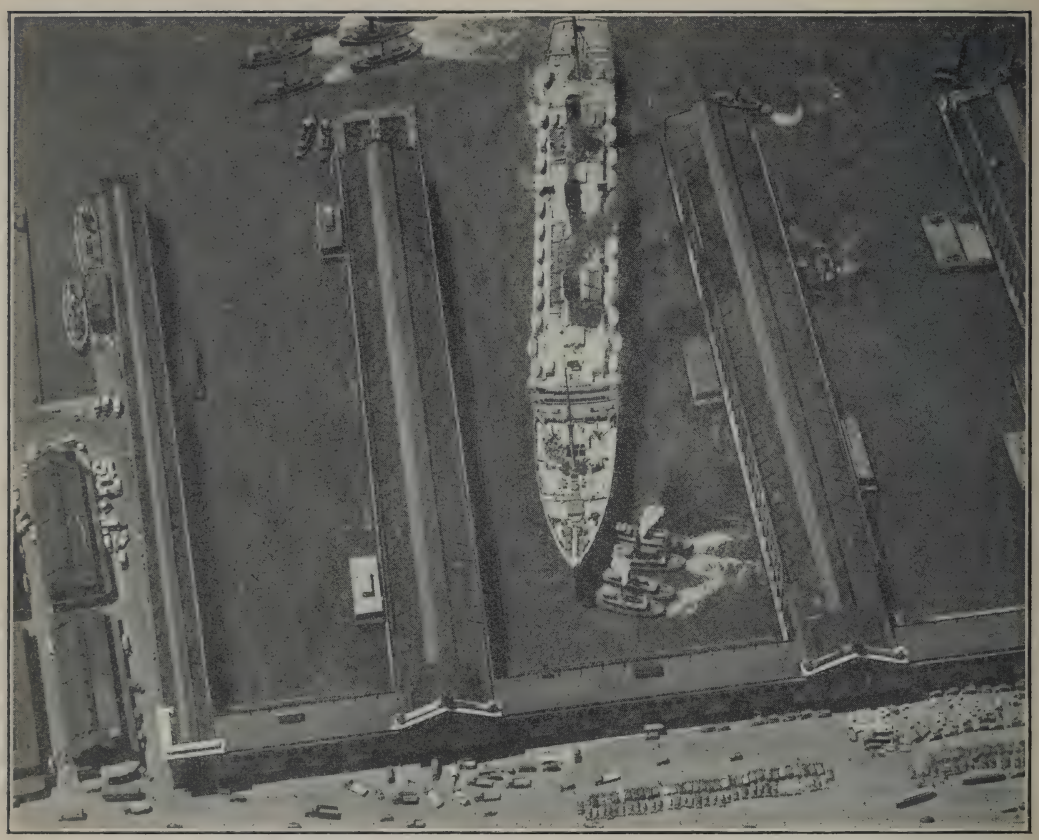
development of directional wireless that the British Admiralty, picking up certain signals radiated by the German flagship to the German fleet, discovered that, while transmitting, the flagship had moved down the River Elbe to the mouth, and so was warned instantly to dispatch the British fleet across the North Sea to fight the Battle of Jutland in the Great War.

For directional wireless purposes the Corporation of Trinity House and other coastal authorities have recently completed the installation at various lighthouses and lightships of a series of Marconi beacon transmitters. These are automatic in operation, being controlled by a master clock which starts and stops the transmitter at regular intervals. Each different transmitter radiates its own individual signal, in flashes of a certain number and duration, and so functions, by wireless means, in exactly the same way as the lighthouse itself, although by reason of weather conditions the latter may be invisible to the ship. Another great advantage is

By courtesy] [*White Star*

ACTIVITY ON THE BRIDGE—BERTHING A LINER

The Captain is in the right foreground, and behind him the pilot; a flag-signaller and the semaphore are seen above; on the left is the searchlight used at night.



By courtesy] *[Cunard Line*

THE END OF THE VOYAGE
TEN TUGS DOCKING THE "BERENGARIA" AT NEW YORK

that any number of ships can pick up the same beacon signal simultaneously, so avoiding the confusion which occurs when numerous ships try to call up the same land station by means of wireless, to ascertain their positions. By means of underwater transmissions, known as submarine signalling, buoys and light-vessels also transmit valuable information in all weathers to the navigators of the ship.

The uses of wireless on board ship are ever increasing to-day. Important messages affecting navigation are received from time to time. Amongst these the most vital are those prefixed with the

call sign " TTT," which means a navigation warning—a derelict vessel partially submerged in the vessel's path, or a lighthouse out of action temporarily or a light-vessel shifted, or floating ice, perhaps —and the familiar and insistent " SOS," from a vessel in distress. There are also the weather reports received from shore, which sometimes enable the navigator so to modify the course of the ship as to avoid storms that are brewing in her path.

A fourth essential to navigation is the possession on board of an absolutely reliable timekeeper, known as a " chronometer." This is, in reality, a large and well-made watch, suspended in such a way that, like the compass card, it always remains perfectly horizontal, no matter what may be the position of the ship. It has a special kind of escapement, and by means of a device known as a " fusee " it is absolutely unaffected by heat and cold. These chronometers can generally be relied on not to vary by more than a second a day. A constant check is kept on them by

In Port—The Royal Mail M.V. " Asturias "

observations with the sextant, and further valuable checks are the "time signals" radiated at specified times by the powerful wireless stations on land. Daily, at noon exactly, there is calculated the progress that the vessel has made during the past twenty-four hours.

The navigating bridge is the "brain" of the ship. It is built high up and well forward, so as to command the widest possible view, and at the extreme ends of it are the enclosed wings or "cabs" which enable the navigating officer to see to port or starboard. Outside these are the navigating lights—red on the port side and green on the starboard—which indicate to approaching vessels the direction in which the ship is travelling. In the centre of the bridge are located the wheel-house and the chart-room.

The wheel-house contains the wheel and the steering compass, with the revolution indicator—showing which way the engines are running—and other interesting apparatus. Telephones are installed to all parts of the ship, including the engine-room, the forecastle head, the after-bridge and the "crow's nest" on the foremast, and the all-important "telegraph" to the engine-room, giving the indications "Stop," "Dead Slow," "Slow," "Half-Speed," and "Full" to the engineers on duty, both "Ahead" and "Astern." In the chart-room, where the charts, navigation books and instruments are kept, the charts are studied, and the course of the vessel is plotted with minute care from day to day.

It is little short of marvellous that ships can be brought across several thousand miles of ocean and kept on a direct course from port to port. Week after week the great Atlantic liners cross between Great Britain and America with the regularity of express trains, and, unless anything happens of an altogether unforeseen character, can be relied on to dock almost to the minute of their advertised time. Chart, compass and chronometer have then combined to help the navigator to make what he describes as a "good landfall."

By courtesy] *[Cunard S.S. Co.*

HOLDER FOR MANY YEARS OF THE "BLUE RIBBON" OF THE ATLANTIC.
THE FAMOUS CUNARDER "MAURETANIA."

PART II

PART II

CONTENTS

	PAGE
The History of the Ship	1
How Ships are Propelled	17
Designing, Building and Launching a Ship	33
Crossing the Channel	53
Wonder-Ships of the Navy	65
Floating Towns of To-day	81

By courtesy] [*French Line*

AN OCEAN GREYHOUND OF TO-DAY—THE "ILE DE FRANCE"

Note the Hangar, Slipway and Catapult for the use of Mail-carrying Aeroplanes

THE HISTORY OF THE SHIP

THREE thousand years before the time of Christ, people had learned to sail the sea in ships. Paintings which have been discovered in the tombs of ancient Egypt show vessels of considerable size, propelled by as many as twenty rowers, and often carrying cattle, which were used on the waters of the great River Nile. These were the earliest real ships of which we have any exact knowledge.

In early ships the motive power was provided by human muscle. Long oars were employed in large numbers, and the boats were steered by paddles or sweeps, sometimes as many as four or five. When we come to the days of the Phœnicians, still between seven hundred and a thousand years before Christ, great merchant ships were crossing the Mediterranean Sea in every direction, often pro-

Photo] [*Sport and General*

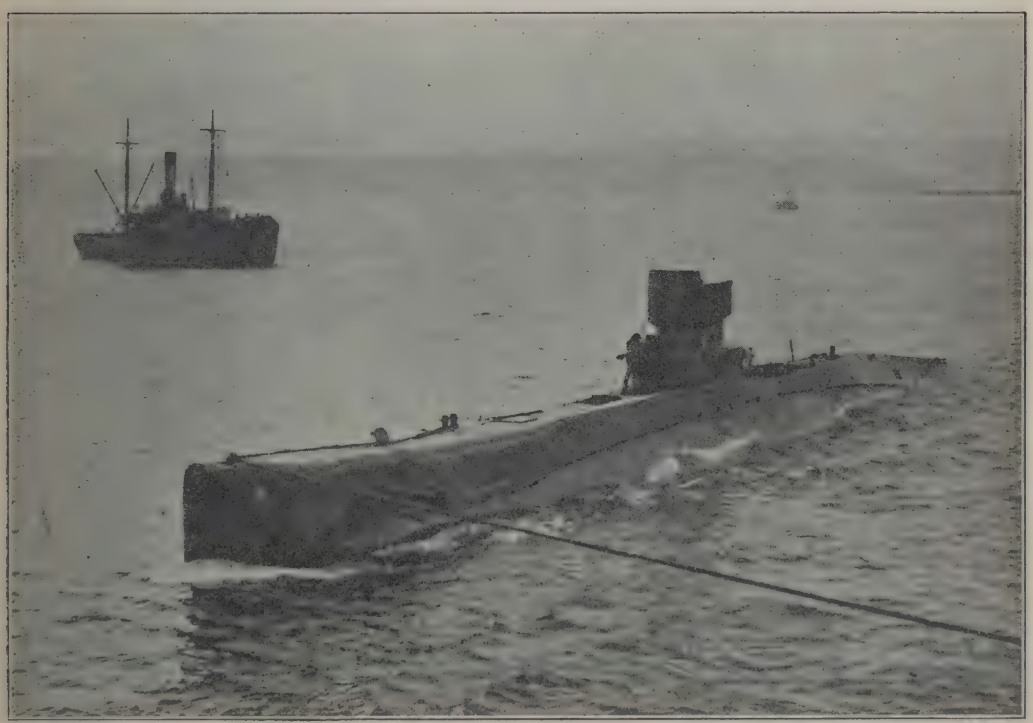
NELSON'S HISTORIC FLAGSHIP OF 1766—THE "VICTORY"

pelled by two or three "tiers" of rowers, one above the other, all working in unison. It was doubtless ships of this kind of which we read in the Bible, bringing to Solomon "gold and silver, ivory, apes and peacocks" from Tarshish, as Spain was then called. It was in one of these Phœnician ships, too, that Jonah tried to run away from his country, with results which we so well know.

Then we come to the days of the Greek ships, of which so much was written by Homer in his "Iliad" and his "Odyssey." These were craft of very striking appearance, with high stems and high sterns. In front, near the waterline, there was the "beak"—a kind of projecting spur with three teeth, covered with bronze, used like a ram in fighting, to tear open the side of the enemy ship, so causing

the latter to sink. Some of these Greek ships, like the "Attic Triremes," were of very great size. The rowers were massed in many tiers, or "banks," sometimes up to sixteen in number; a typical ship of the period would carry a crew of 200 to 225 men, of whom 170 would be rowers.

The Romans now copied this kind of ship. What is more, for their rowers they used to take the most muscular of their war prisoners, making them into "galley-slaves." Each slave was chained to his oar, and certain death by drowning awaited him if the ship were sunk. How terrible was the life you may read in the stirring tale "Ben Hur," in which the hero was punished for a time by being made to serve in this way. It was in one of these Roman ships, on the voyage from Palestine to Rome as a prisoner, that St. Paul was



Photo] [*Sport and General*

WARSHIPS OF TO-DAY—THE "Q" SHIP "STOCKFORCE," AND A SUBMARINE

wrecked off the island of Malta ; and we can realise the size of the vessel by the fact that, as the careful historian St. Luke tells us, the crew and passengers numbered in all 276 persons.

At the same time the Vikings were striking terror into the people of our own little island by the ships in which they came on their marauding expeditions from Norway. The remains of one of these boats was discovered not long ago, in a mound near the capital city of Oslo, almost intact. It was 78 feet long, 16 feet 7 inches broad, and 5 feet 9 inches deep ; the " machinery " consisted of 64 oars, and into this small space there was crowded a crew of 240 men.

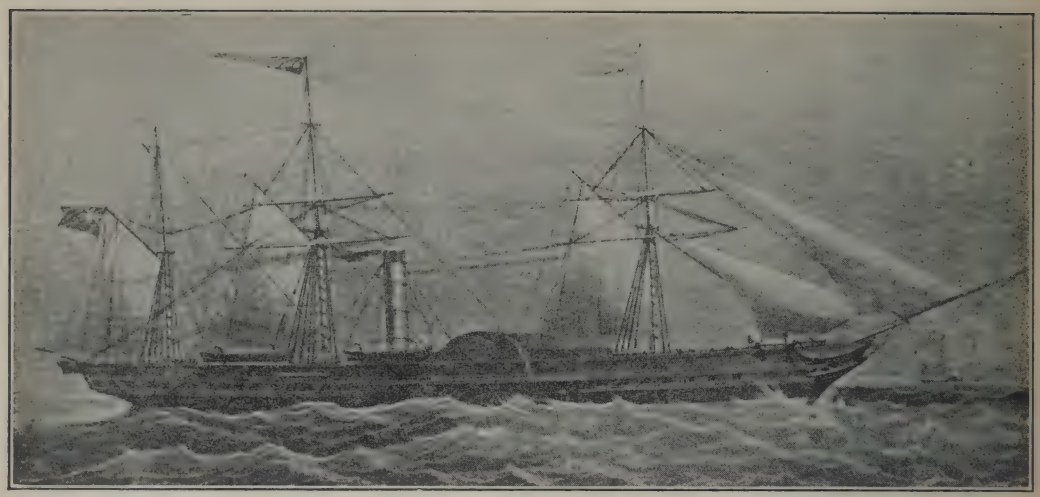
As we come to mediæval times, we find that the design of the ship was beginning to change somewhat. Rowers were still used, but the oars were becoming much more massive. From 30 to 50

THE LAST OF THE BRITISH " WINDJAMMERS "— THE " GARTHPOOL "

THE "GARTHPOOL" LEAVING THE HUMBER ON HER LAST VOYAGE

feet was a common length for an oar, and one oar was now "manned" by five, six or even seven men. Rudders, too, were beginning to come into use for steering. It was in ships of this kind that Richard Cœur de Lion set out on the Crusades, at the end of the twelfth century. On that ill-fated expedition, to free the Holy Land from the hands of the Saracens, 110 ships set sail from Dartmouth, increased in the Mediterranean to a fleet of 230 in all.

By now the seaman was beginning to realise that there was another force of Nature which he could bring to his aid, in addition to the buoyancy of the wood which enabled his vessels to float. This was the wind. It was a rather uncertain assistance, it is true; sometimes it would fail to blow when it was wanted, and sometimes it would blow in exactly the wrong direction. But when the wind was favourable, the use of sails enabled a ship to cover great distances at sea without any human effort. And by degrees the sailor learned how to design his masts and sails in such a way as to make use, by "tacking" and in other ways, of every breath of wind, no matter from which direction it blew. So came in the long reign of the sailing ship.



ONE OF THE FIRST CUNARDERS—THE "BRITANNIA," 1840

As the science of sailing became better understood, so the use of the oar gradually lessened until it disappeared entirely. From the year 1400 onwards sailing ships of great size began to be built. "Caravels" and "carracks" of the fifteenth century ranged in weight from 420 to as much as 1,000 tons. The caravel was a vessel very broad in the beam; so much so, indeed, as in shape to resemble a barrel cut in half lengthways. It had high raised ends, a double tower at the stern being known as the "sterncastle," and a single tower in the bows called the "forecastle"—a term which is still in use to this day.

It was in ships of this type that many of the world's most famous voyages of discovery were made, the Spaniards and the Portuguese, in particular, being responsible for some of the most memorable of these exploits. In 1492 the flagship of Christopher Columbus—the *Santa Maria*—carried him across the Atlantic Ocean to the discovery of America. In 1497 Vasco da Gama made his voyage round the Cape of Good Hope. The same year saw the discovery of Newfoundland by John Cabot.

The next century or two saw further changes in the design of ships, due to the increasing use of cannon and other kinds of armament.

There was little or no distinction, in those days, between what to-day we class separately as " The Navy " and " The Merchant Marine." All merchant ships had to be heavily armed, in case they fell in with enemies or pirates, and the same vessels served for carrying passengers or cargo, or, if necessary, for fighting. A typical Portuguese carrack of this period measured 165 feet long by 47 feet broad and was armed with 32 brass guns ; she could carry between 600 and 700 passengers. The Spanish Armada, which in 1588 thought to strike terror into our country, consisted of 132 such ships, the biggest of which were vessels of 1,300 tons.

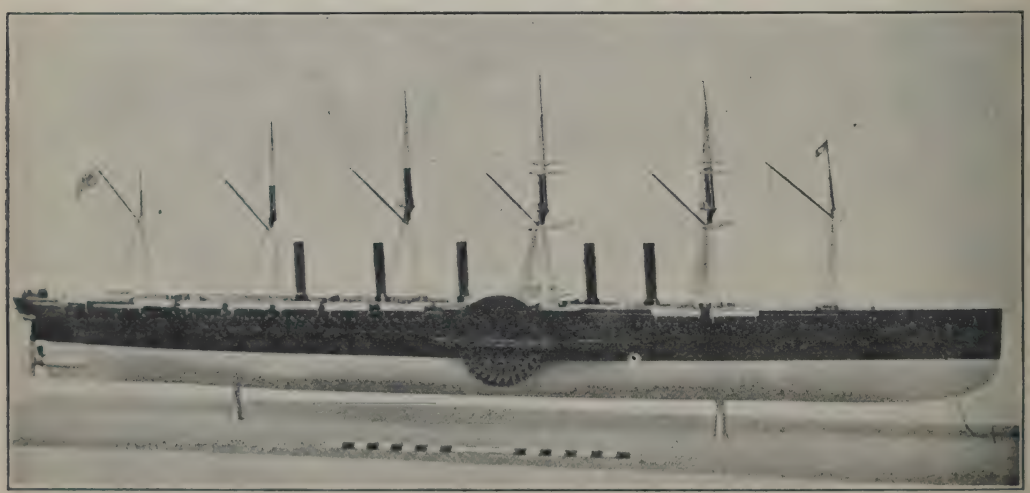
In the seventeenth century there was a rapid and unceasing increase in oversea trade, and shipbuilding became a more and more important industry. The best material of its time for ship construction was English oak, and to its use, largely, may be traced the superiority of the English ships during this and the following centuries. For the development of this trade by sea aroused many international jealousies, and England was not to become " Mistress of the Seas " without many hard struggles. When the East India Company was formed, its vessels had literally to fight their way to and from India,

THE LAST TRANSATLANTIC PADDLE-STEAMER—THE CUNARDER " SCOTIA "

the worst obstruction coming from the Portuguese. The Dutch, too, were becoming strenuous competitors.

In the eighteenth century a more definite distinction began to be made between the " ships of the line," or the men-of-war proper, and the armed merchantmen. A typical fighting ship of this period was Nelson's flagship *Victory*, built in 1766 and still preserved in splendid condition at Portsmouth. She was 182 feet long, 52 feet beam, and of 2,162 tons displacement ; she carried one hundred guns. But the armed merchantman was neither one thing nor the other. The space taken up by the guns and their stores reduced the space available for cargo and passengers. On the other hand, the gunners were hampered by the cargo-strewn decks when working their guns, and the guns themselves were but small and light. In fact, the merchantman was forbidden by law to carry too many guns, or too powerful, lest she herself should turn pirate.

To obtain better speed, the area of sail now carried by these vessels was greater than ever before. Ships had become " fully rigged," their three tall masts carrying generally a " square rig "—that is, sails set on " yards " which are roughly at right angles to the keel



From a Model] [*Science Museum, South Kensington*

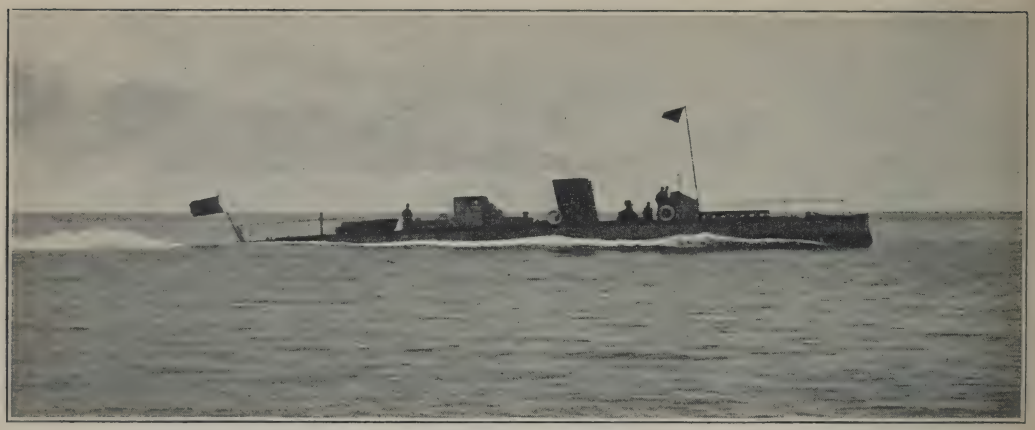
THE FAMOUS " GREAT EASTERN " OF 1858

of the vessel. Strictly speaking, the word "ship," though now used in a general fashion to refer to vessels of all kinds, is the name of a sailing vessel with fore-mast, main-mast, and mizen-mast, all square-rigged.

Photo] *[Sport and General*

A Five-masted Schooner with Auxiliary Steam-power

The influence of "lines" upon speed was also beginning to be realised, and after the "Blackwall Frigates," of the heavily-built, full-lined type of ship up till that time usual, there came the "Baltimore Clippers," designed on much finer lines. The name "clipper" arose from the alteration to the bows which was necessary in order that these vessels might "clip" or cut through the water at a greater speed. This meant cutting away the clumsy rounded bow which had, until then, been customary, and designing the slender bow, tapering gradually and gracefully from the bowsprit, which soon came into widespread use. This alteration meant less cargo space, but by now growing passenger traffic across the seas, and special kinds of cargo on which shippers were prepared to pay high rates of freightage, made such vessels a paying proposition. Ships of this kind were very uncomfortable, as in rough seas they shipped a great deal of water; but they were



By courtesy] [*Swan, Hunter, Wigham Richardson*

THE FIRST TURBINE STEAMER—" TURBINIA," 1894

fast and seaworthy. One particular kind of trade with which the clippers are generally associated was the tea trade from the East, now growing to considerable volume. Who has not heard of such famous vessels as the *Cutty Sark*, the old China clipper which broke all records in the 'seventies and the 'eighties ?

At this stage of its development the fully-rigged sailing ship was one of the most beautiful objects that the ocean has ever seen. " Fore and aft " sails of various descriptions had been added to the " square rig," and a three-masted ship of the period often carried between twenty and thirty sails of different kinds. Further masts were added, up to five in all, and in America schooners have been constructed with as many as six masts carrying fore and aft sails only.

But by now we have come at last to the days of steam and iron. Just as the sail was first introduced as an assistance to the oar, so steam first came into use on the sea as an auxiliary to sails. Iron began to come into favour for ship construction at about the same time. The fight for both these revolutionary developments was a hard one. Iron, it was said, was sinkable, whereas wood was not.

One of the most determined opponents of both changes, strangely

enough, was the British Admiralty; their objection to iron, in particular, was that an iron ship would, they claimed, suffer worse damage from enemy shot than a wooden ship!

One of the earliest actual "steamers" was the *Charlotte Dundas*, built by a man named Symington, and first used on the Forth and Clyde Canal. Then came Fulton's *Clermont*, built in America, but provided with engines by the famous English firm of Watt and Boulton; she was used between New York and Albany on the River Hudson, and became very popular. And it was to canals and inland waterways, where sails had very limited value, that the steamship was at first confined.

Then came steamers built to cross the North Sea, the Irish Sea and the Straits of Dover. It was one of these vessels for which is

A 20,000-ton Liner on the Australian Service—The "Orford," of the Orient Line

By courtesy] *[Southern Railway*

A Striking Aerial View of Southampton Docks

Three of the world's biggest ships can be seen ; in the foreground, the American liner " Leviathan " ; on the opposite side of the Ocean Dock, the White Star " Olympic " ; and in the floating dock, the Cunarder " Mauretania "

claimed, in 1827, the honour of having first crossed the Atlantic Ocean by steam—a Dutch packet named *Curaçao*, of only 438 tons register. It took her a month to reach the West Indies. In 1838 the steamer *Great Western*, of 1,440 tons register, succeeded in halving this time, making the crossing from Bristol to New York in 15 days, a then unheard-of time for an Atlantic crossing. She had been built with the idea of " extending " our English Great Western Railway to America !

The first regular Transatlantic service was that established by Samuel Cunard in 1840, and continued to this day by the well-known steamship company which still bears his name. Four sister ships—the *Britannia*, *Acadia*, *Caledonia* and *Columbia*—were built for this service. Each one was 207 feet long by 34 feet beam, and had a depth of hold of 22 feet ; they were all driven by paddle-wheels, and in favourable weather could do about 9 knots. A " knot," by the way, is the unit of speed by sea, and is rather over nine furlongs in length ; 9 knots, for example, work out at a shade less than $10\frac{1}{2}$ miles per hour.

The next change of importance was in the method of propulsion. Hitherto the paddle-wheel had held the field alone. The principle of propulsion by a screw was not new, but till now it had not been applied to a steamship. In 1836 an Englishman named Smith and a Swede named Ericsson both patented screw arrangements for driving ships, and in 1839 two steamers—the *Archimedes* and the *Robert F. Stockton*—were built embodying screw propellers. Neither of the ships was of great size, but in their working it was clearly shown that by screw propulsion more power could be developed at less expense in the matter of fuel. For all that, it was many years before the screw came to be looked upon as the most suitable method for driving large liners. To-day the paddle-wheel only survives on the pleasure steamers which work round our coasts in the summer-

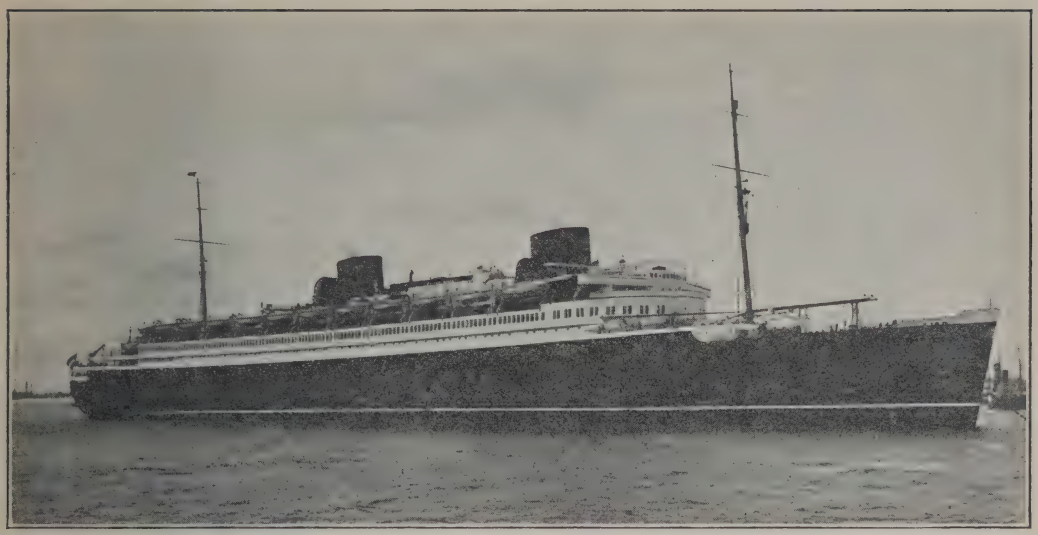
time and also on steam tugs; for such small vessels the paddle has certain advantages, and especially that of greater steadiness.

Similarly the upholders of iron as a better material for ship construction than timber were having a hard fight for recognition. The Cunard Company built its first iron steamer—the *Persia*—in 1856, and its last and finest paddle-driven steamer—the *Scotia*, 3,871 tons—in 1862.

One of the most fiercely discussed ships that has ever been built was the famous *Great Eastern*, of 1858. No vessel of such size had up till then been thought or dreamed of. She was 692 feet in length, 82½ feet in the beam and of 30 feet draught, and of no less than 18,914 gross tonnage. To obtain sufficient power, Brunel, her designer, arranged for driving her by paddle-wheels as well as by a screw, and in addition to this six masts were provided, carrying 6,500 square yards of canvas.

The *Great Eastern* was built to run a service to the East, and so to carry sufficient coal for very long voyages. But owing to an accident in launching, which delayed completion by three months and proved very costly, the company which had built her failed, and another company bought her to work across the Atlantic, for which

THE WORLD'S BIGGEST LINER—THE WHITE STAR "MAJESTIC," 56,620 TONS



THE WORLD'S FASTEST LINER—THE NORTH GERMAN LLOYD "BREMEN"

the great vessel was altogether unsuitable. The *Great Eastern* did, however, at least render us one valuable service; she was responsible for the laying of the first Transatlantic telegraph cable.

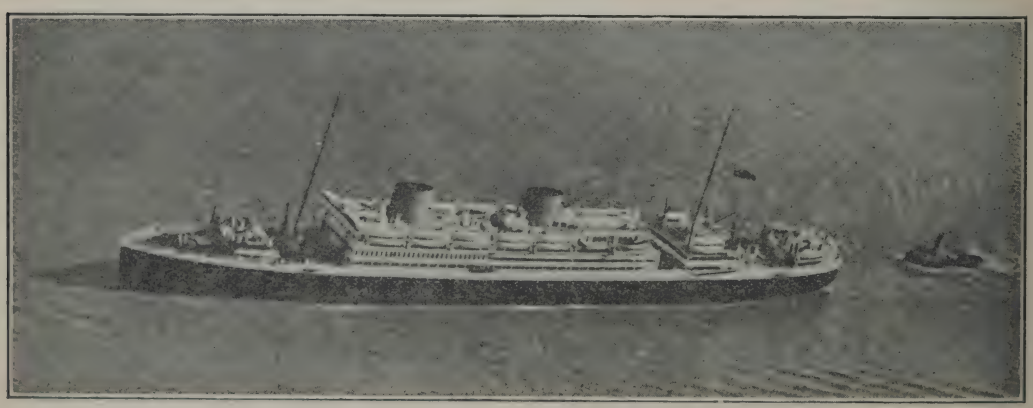
In the last fifty or sixty years marine developments have followed hard on the heels of one another. Steel, first introduced in the late 'seventies, has long since replaced iron in shipbuilding, and timber construction for large vessels is a thing of the past. Similarly, sails have been abandoned on the steamship, new types of machinery having been devised which have made steam propulsion altogether more efficient than it was in early days.

Then there came in the vastly important discovery of the steam turbine, and the equipment by the Hon. Charles Parsons, the inventor, of the small steamer *Turbinia* with this method of propulsion in 1894. Her speed of $34\frac{1}{2}$ knots (all but 40 miles an hour) was the marine sensation of her day. But owing to one or two accidents to turbine-driven ships, it was not until the beginning of the present century that the steam turbine came into favour for passenger ships.

For making steam quickly and economically, "water-tube" boilers

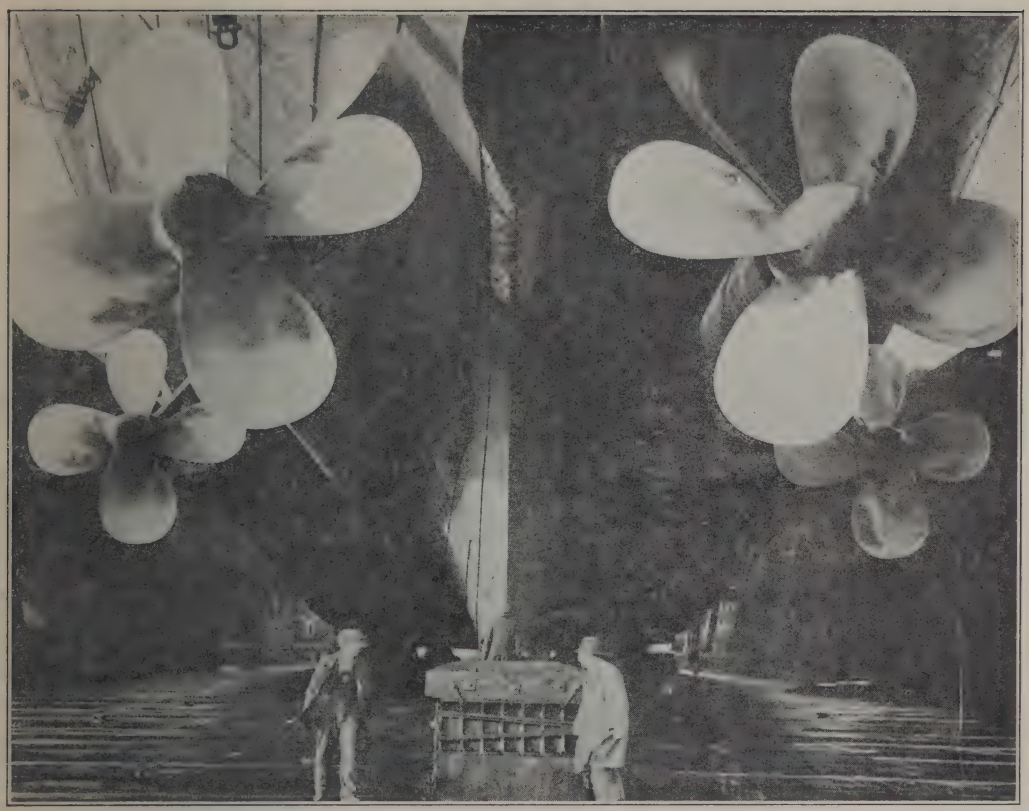
have come in to replace the older types, and oil is largely used as a clean and efficient substitute for coal, needing less space for its storage and doing away with much of the labour in the stokehold. By the help of oil, too, steam can be dispensed with altogether, as in the latest "motor-ships" the internal combustion engine, of the Diesel type, has displaced the boilers and engines of the familiar steamship.

But we have now come to our own times, and other chapters will tell you in more detail of their developments. One can only wonder what some of the early shipbuilders would say could they set eyes on one of our giant liners of to-day. The 56,620-ton *Majestic*, for example—910 feet long, 100 feet beam, and with 57 feet depth of hold—is a floating hotel of enormous size, carrying over 3,000 passengers, who live in the utmost luxury, and a crew of 800 or so, and proudly claims the title to be the largest ship in the world. Or the *Bremen*, which has recently wrested from the gallant old *Mauretania* the "Blue Riband" of Atlantic speed, by crossing from Ambrose Channel Light, near New York, to Cherbourg in 4 days 15½ hours, thus bringing New York within five days of London by ordinary sea transit. Such has been the progress of the past five thousand years. And the amazing reflection is that by far the major part of it has been crowded into one brief century.



A Modern Motor-Ship—The "Asturias," of the Royal Mail

A VIKING SHIP OF LONG AGO.



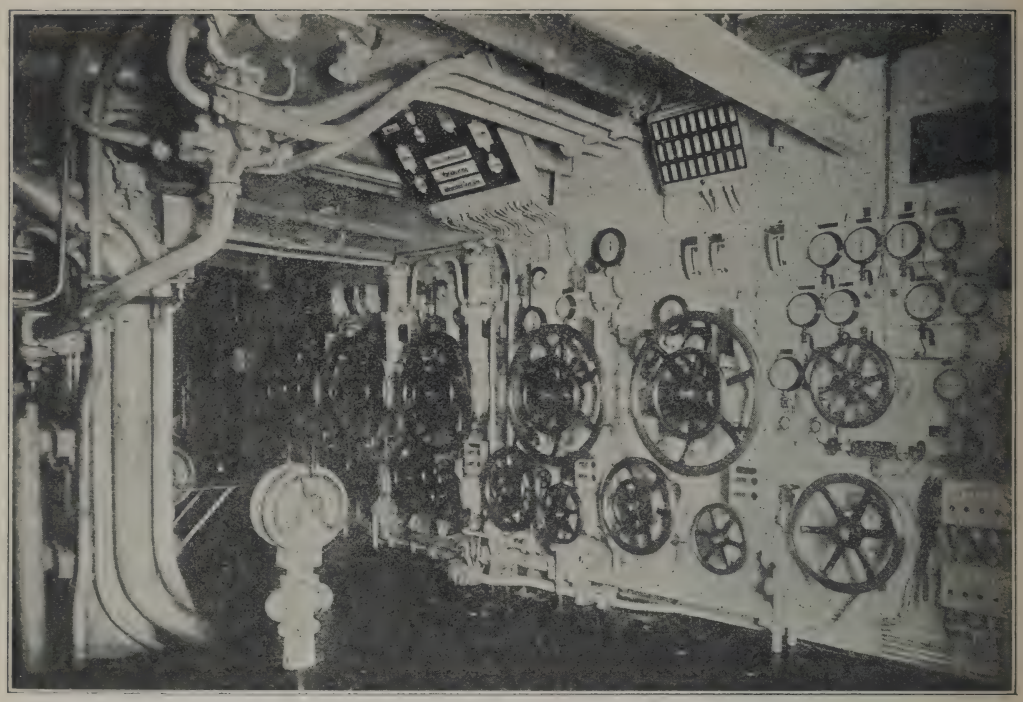
Photo] [*Photopress*

A Study in Screws—The Four Propellers of the "Majestic"
The ship's rudder has been removed for repairs

HOW SHIPS ARE PROPELLED

IN designing a modern ship one of the matters of most vital importance is the method by which it is to be propelled. If steam is to be used, shall it be by means of cylinders and pistons and reciprocating motion, or by the silent and smooth-running turbine? Or shall a combination of both be employed? Shall the steam itself be generated in ordinary marine boilers, or in water-tube boilers? Yet again, shall coal be the source of heat for firing the boilers, or shall it be oil?

If oil is to be used, shall it not be in the most economical of all



By courtesy] [*White Star Line*

THE CONTROL PLATFORM OF THE "MAJESTIC"

ways, by explosion rather than combustion, in the cylinders of internal-combustion engines, like those of motor-cars only vastly bigger? Or why not employ those same internal-combustion engines to drive dynamos, and so to generate electricity for propelling the vessel by means of electric motors? These and other methods still present themselves in bewildering variety to the designer of a ship. Each method has its own advocates, and each may be found embodied in one or another of our biggest liners to-day.

Most of us have probably made the acquaintance of the reciprocating marine engine, when travelling in the paddle-steamers which make their pleasant jaunts to and from the pleasure resorts round our coasts. Going down below, we have seen the great cranks steadily swinging round, joined by means of the connecting-rods to the cross-heads, which move smartly forwards and backwards at the

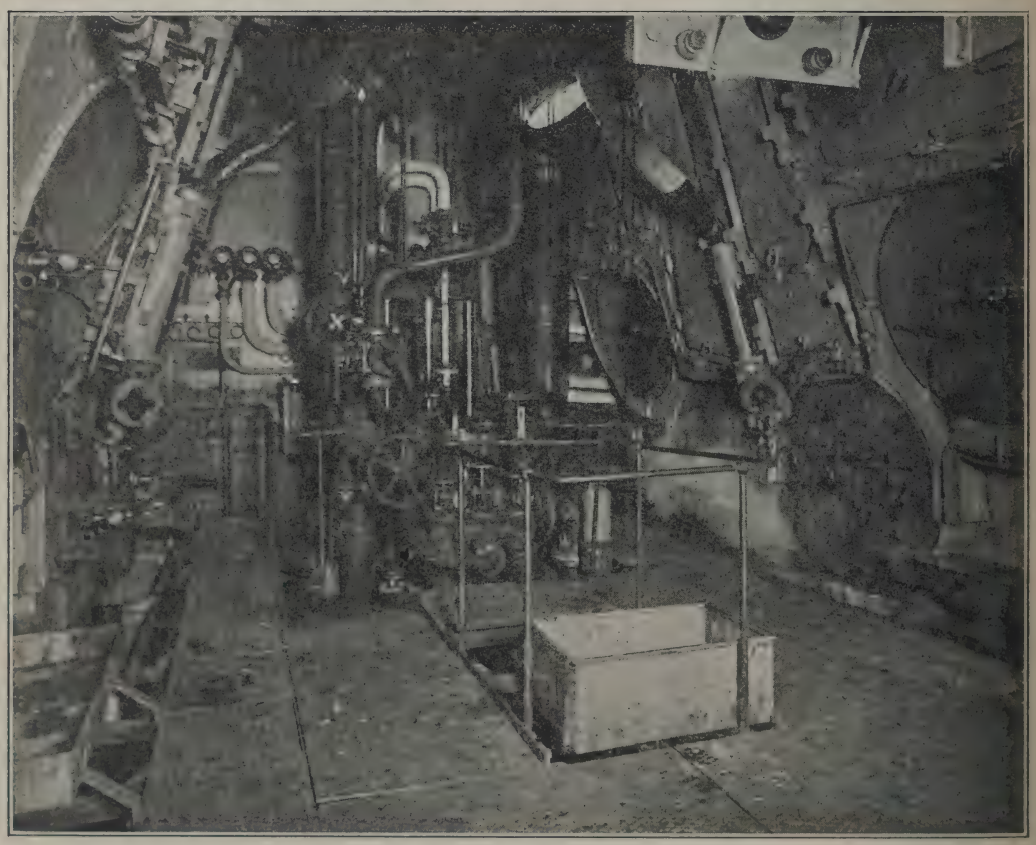
end of the piston-rods. A two-cylinder engine is usually of sufficient power to meet all demands on a modest craft like this. The cylinders are either arranged horizontally or at an angle, inclined upwards, and as boats of this type are paddle-driven the crank-shaft is at right angles to the centre-line of the ship, running across the vessel amidships, and terminating at both ends in the paddle-wheels.

As we have already seen in the chapter entitled " The History of the Ship," all the earliest steamers were paddle-driven, even including the first Transatlantic liners. But then followed the discovery of the principle of screw propulsion. This not only proved to be in itself a more economical method of driving than the paddle-wheel, but did away at the same time with the breadth of beam entailed by large paddle-boxes, so reducing the resistance of the vessel to rapid motion through the water.

At the same time the change altered the position of the engines. Propeller-shafts, running longitudinally along the ship from amidships to the stern, replaced the transverse crank-shaft. The screws were well below water, also, whereas the centre of the paddle-wheels had been above the water-line ; so the engines now came to be set up on end, with the driving-shafts below them. The general arrangement of the modern reciprocating marine engine is that the cylinders, arranged vertically, are carried by steel columns, which in their turn are made to provide the parallel guides for the cross-heads in their up-and-down motion. As in the case of the locomotive, a suitable valve-gear is installed, not only for the purpose of reversing the engines but also to allow of cutting off the supply of steam to the cylinder when the piston has only travelled for a portion of its stroke. For the remainder of the stroke the steam does its work by expansion.

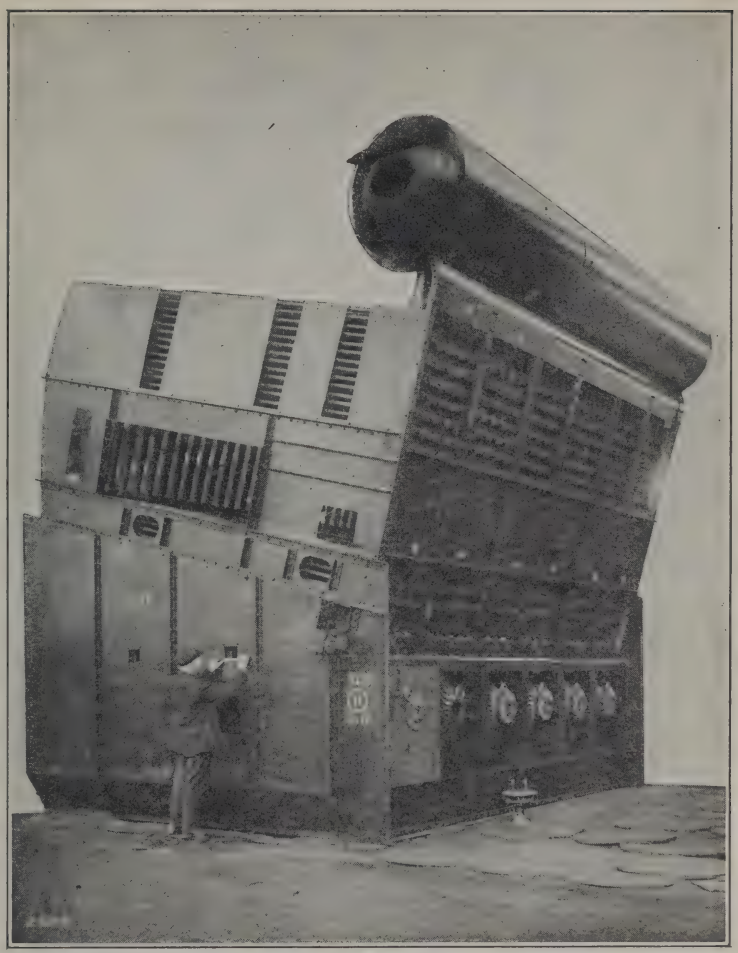
Many years ago it was realized that this capacity for expansion could be put to greater use. From the first, or " high-pressure "

cylinder, therefore, the steam was led in its partially-expanded state to a second cylinder of larger dimensions, in which further expansion was carried out. This principle is known as " compounding." From the " double-expansion " idea there have since developed " triple-expansion " and " quadruple-expansion " engines, embodying three or four cylinders in series, growing successively bigger in dimensions from the high-pressure cylinder to the cylinder in which the last stage of the expansion is conducted. The same volume of steam is thus made to do more work, and there are other advantages, too technical to enter upon here, which help to make



A View in the Stokehold of the Giant Cunarder " Aquitania "
Steam is raised on this ship in oil-fired marine boilers

compound propulsion a more economical way of using the steam than the original single-expansion method. After the steam has done its work in the cylinders, it is carried to condensers, where in condensing it helps to warm the feed-water for the boilers, so that none of its heat is thrown to waste.

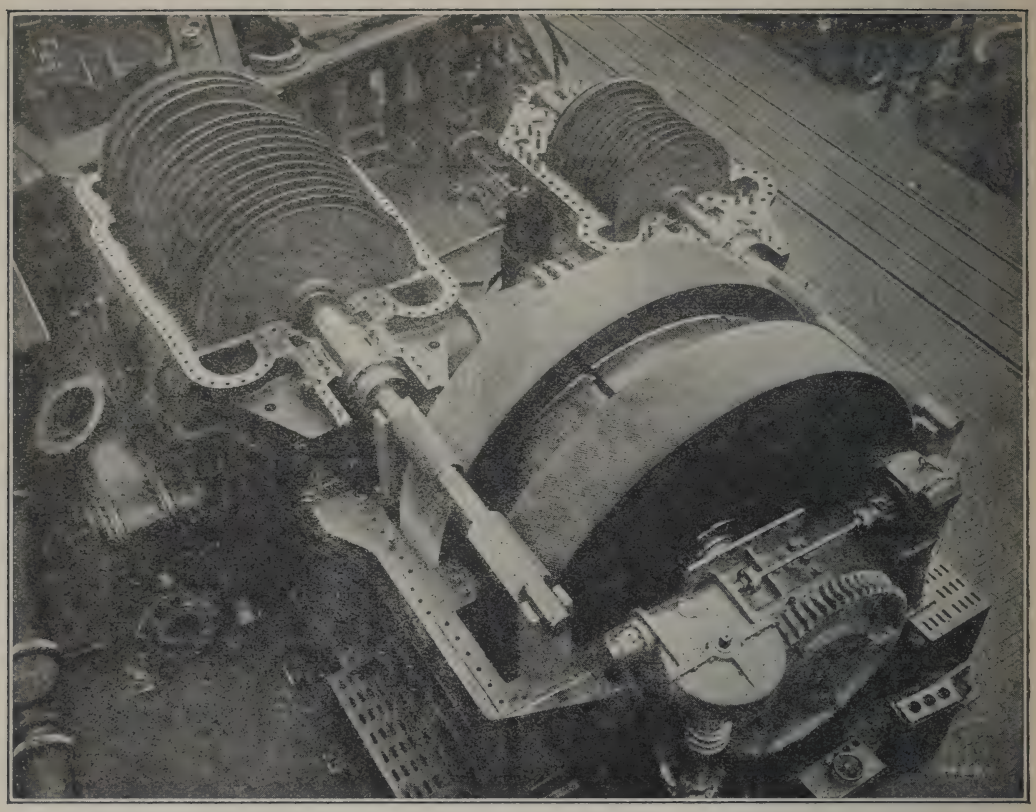


By courtesy] [*Harland & Wolff, Ltd.*

A Modern High-Pressure Water-Tube Boiler

Notice the steam-drum above, the water-tubes in rows behind the casing, and the oil-jets at lower right-hand side, with control valves

For the past thirty years the reciprocating steam engine has had a formidable rival in the steam turbine. A turbine is a large steel drum whose outer surface is covered with innumerable fine brass blades projecting outwardly ; it is fixed on a shaft and enclosed in a cylindrical casing which also is lined on the inside with fixed blades or guide vanes. There is very little distance left between the turbine blades and the vanes, and the steam, on entering the casing through suitable nozzles, causes the turbine or " rotor " and its shaft to rotate



By courtesy] [*Harland & Wolff, Ltd.*

A Set of Geared Turbines with Covers Removed

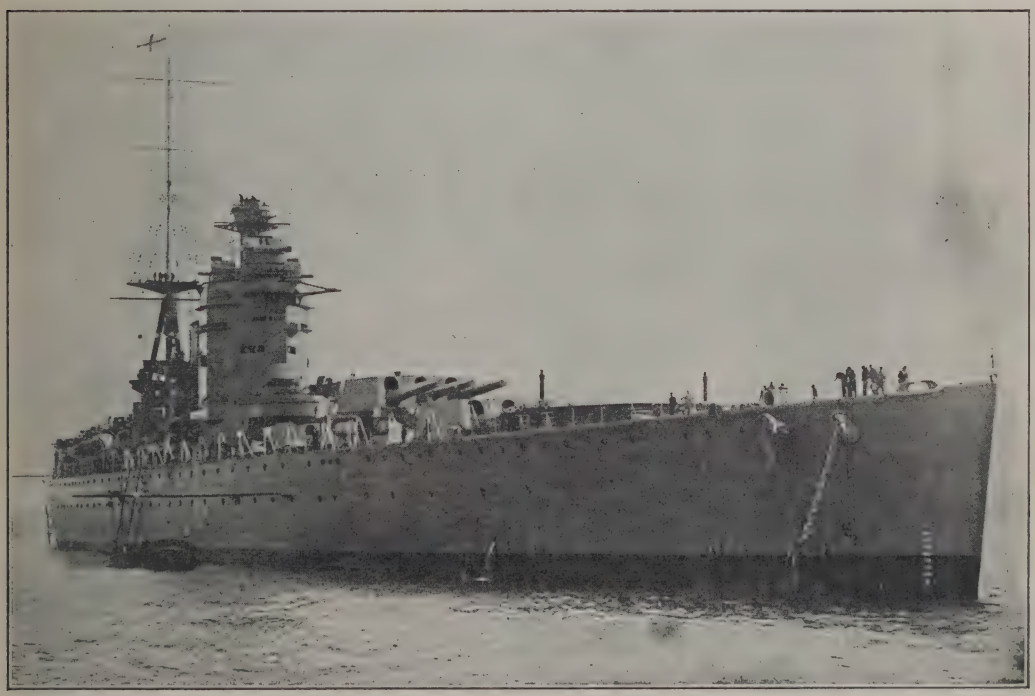
High-pressure turbine in left background ; low-pressure turbine in right background (the " vanes can just be seen in the grooves of the rotor), and gearing in foreground

rapidly. Turbine propulsion of ships has many advantages. The turbine rotates more evenly and smoothly than a shaft driven by reciprocating engines, with their heavy parts, and vibration is thus reduced to a minimum. Turbines, too, have fewer independent moving parts, such as pistons, slide-valves and connecting-rods, so that there is less liability to failure. The turbine, also, is more economical than the reciprocating engine.

It is customary to work marine turbine sets compound fashion, a high-pressure turbine being used for the first stage of expansion, then a larger intermediate turbine, and then a still larger low-pressure

turbine. In the largest and fastest ships from two to four separate sets of turbines may be employed; the *Bremen* and *Europa*, for example, both have four sets, each set of three turbines driving one of the four propeller shafts. Independent turbines are installed for working the vessels astern when necessary. Sometimes a combination of both reciprocating engines and turbines is employed, as in the big White Star liner *Olympic*. This vessel drives her two wing propellers by high-pressure reciprocating engines, from which the steam is exhausted into a large low-pressure turbine driving the central propeller-shaft.

One disadvantage of turbine propulsion is that, to get the most efficiency out of your turbine, it must be run at very high speeds. For the highest propeller efficiency, on the other hand, considerably



By courtesy] [*L.N.E.R.*

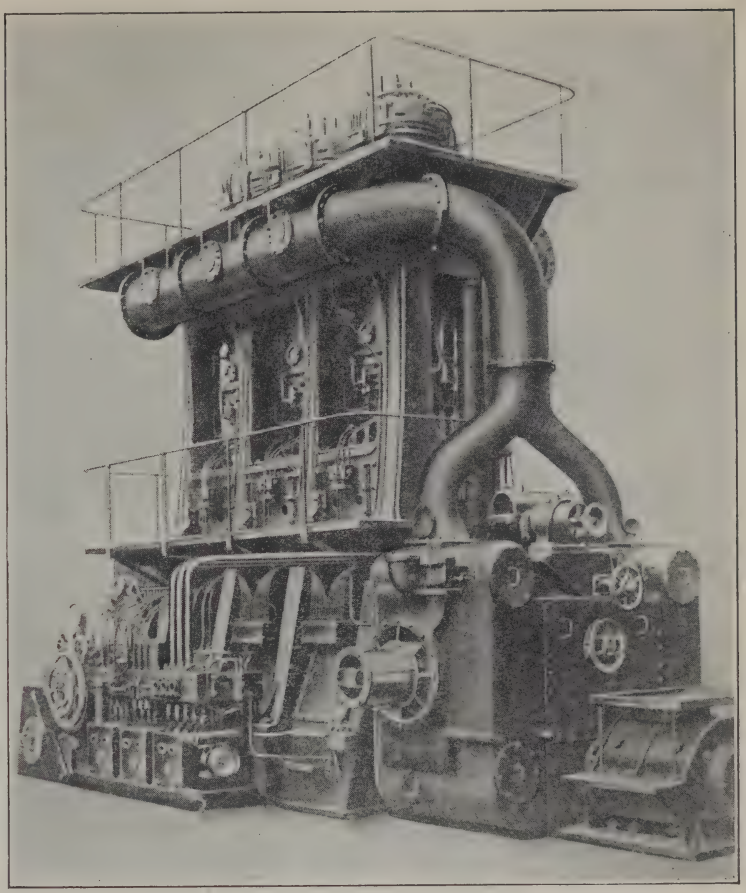
DRIVEN BY A COMBINATION OF OIL-FIRED WATER-TUBE BOILERS AND STEAM TURBINES—H.M. BATTLESHIP "NELSON"

lower speeds are desirable. This difficulty has now been got over by means of the " geared " turbine, in which mechanical reduction gearing is introduced between the turbine or turbines and the propeller shaft. In the *Bremen* and the *Europa*, for example, the turbines run at no less than 1,800 revolutions per minute, but by gearing this is reduced to the 180 revolutions per minute at which the propeller-shafts revolve. Geared turbines are coming increasingly into favour, especially for fast passenger boats.

We now come to the methods of raising steam. Two totally different methods are employed. The older is the marine boiler. A modern boiler of this type is like a short section of a large diameter steel pipe, closed at both ends. On the firing side there are three or four large flues, into which the fuel is fed. The heat is drawn into a large combustion chamber or fire-box at the opposite side of the boiler, whence it passes back by hundreds of small-diameter tubes to the front of the boiler again, after that to be carried by big vents up into the chimney. Each of these tubes is full of heat and surrounded by water. Sometimes marine boilers of this type are fed with fuel from both sides, in which case they become " double-ended " instead of " single-ended."

THE WORLD'S BIGGEST MOTOR-SHIP—THE NEW WHITE STAR LINER " BRITANNIC," 27,000 TONS

But the rival of the "water-tank" boiler of this type is the "water-tube" boiler. This consists of rows and rows of tubes running upwards from two water-drums at the side of the boiler to a larger steam-drum above. Here, then, the water is not round the tubes, but inside them, and by means of suitable draught arrangements and casings the heat from the fuel is made to pass through these serried ranks of tubes, so rapidly converting their water into steam. As with the locomotive engine, so in the marine boiler the tendency is for steam pressures to rise, in order that better use may be made of the expansive properties of the steam. A lead in this direction has been given by the well-known turbine-driven pleasure steamer *King George V* on the Clyde, whose boilers produce steam at no less than 550 lb. per square inch.

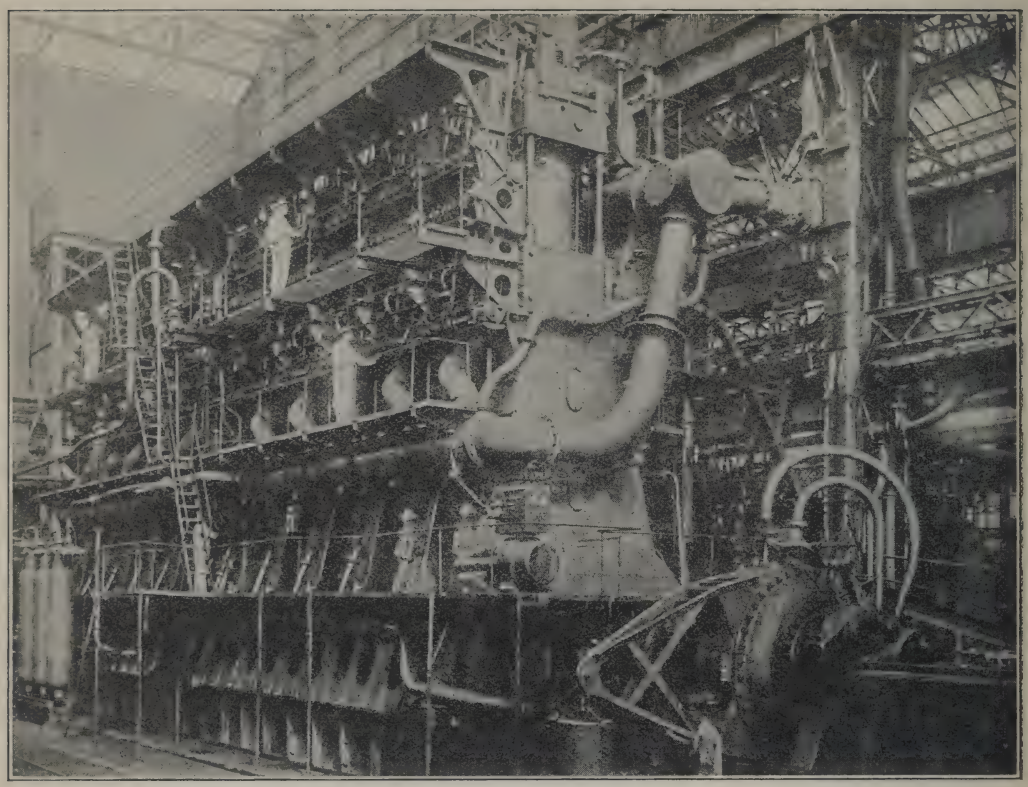


By courtesy] [*Richardsons, Westgarth & Co.*

TWO-STROKE OIL ENGINE FOR THE M.V. "IRANIA"

The first all-British machine to be built on the double-acting two-stroke airless injection principle

And now a word about the source of the heat by which steam



THE 10-CYLINDER STARBOARD ENGINE OF THE WHITE STAR "BRITANNIC"

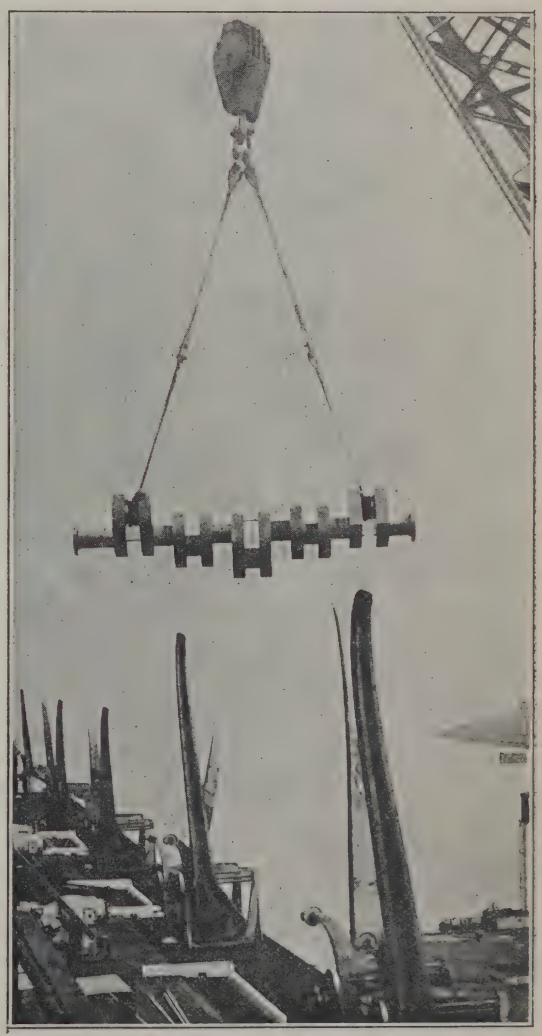
is raised. Here the contest is between oil and coal. Coal is the older method of firing and oil the newer. Why is oil so popular? First of all, because of the tremendous saving of labour that it renders possible. Instead of transferring perhaps 1,000 tons of coal per day by hand from bunkers to furnaces, in one of the biggest modern Transatlantic liners, the work of the stokers is reduced to the vastly less laborious task of controlling the oil-feeds. When the great Cunarder *Aquitania* was converted from coal-firing to oil-firing, her crew of stokers was brought down from 320 to 42!

Oil-firing has many other advantages. As compared with the dirty and strenuous labour of shipping coal into the bunkers taking oil on board is a quick, clean and simple operation—a consideration

of no small importance in the case of a passenger liner. With oil there are no cinders or ashes to be withdrawn from the furnaces from time to time, nor is there any need to open the furnace doors when fuelling, so that loss of heat for this reason is avoided. Yet again, roughly three-quarters of a ton of oil will produce the same amount of steam as a ton of coal, so that oil-firing means that less of the precious space inside the ship is taken up by storage space for fuel.

With these substantial advantages, where do the disadvantages come in? First of all, there is the all-important disadvantage of cost—oil-firing is so much the more expensive of the two methods, indeed, that it is never likely to become general in other than fast passenger liners and warships. There are also to be considered the complications of piping, the possible dangers of fire through leakage, and the fact that the world's supplies of oil are much less extensive, and found in far fewer places, than her unbounded supplies of coal.

This brings us to the more modern and the more efficient use of oil as a propellant, not by burning it but by exploding

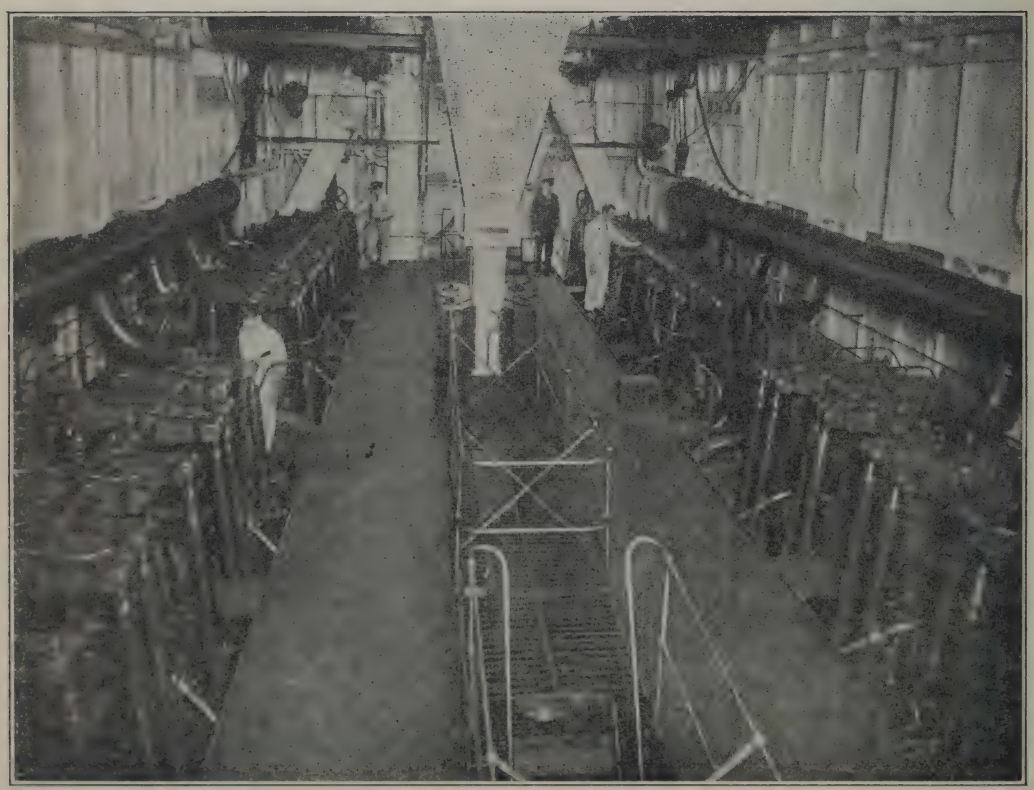


By courtesy [*White Star Line*

LIFTING ONE OF THE TWO 185-TON CRANKSHAFTS INTO THE "BRITANNIC"

oil-vapour in an internal-combustion engine. Although this method, as compared with steam, is still in its infancy, yet the "motor-ship" to-day is becoming a powerful rival to the steamship, whether as a freight or a passenger vessel. The largest motor-ship yet built is the *Britannic* of the White Star Line, of 27,000 tons displacement, and roughly one-half of the world's new shipping tonnage is being built in the form of motor-ships. But the principle has not as yet been applied to any high-speed passenger liners or warships, which continue to rely on steam.

It is the Diesel oil-engine, with various modifications and improvements, which is usually employed in marine work. There are two



By courtesy] *[Royal Mail*

THE ENGINE-ROOM OF THE "ALCANTARA"
Showing the cylinder-tops of the four groups of Diesel engines

By courtesy] [*Royal Mail*

THE MAIN ELECTRIC SWITCHBOARD OF THE "ALCANTARA"

main types in use—the two-stroke, in which one journey of the piston up and down the cylinder completes the "cycle," and the four-stroke, in which two return strokes of the piston are needed, the first drawing air into the cylinder and then compressing it, while the explosion and the expansion of the burnt gas, followed by the sweeping of the exhaust out of the cylinder, take place on the second return stroke. Diesel propulsion is nearly twice as efficient as propulsion by steam from oil-fired boilers and geared turbines, and the fuel bill is thus halved; the space occupied by engines and boilers is greatly reduced and a very much smaller engine-room staff is needed. But against this the Diesel engine is complicated and costly to build, and the large number of its working parts means

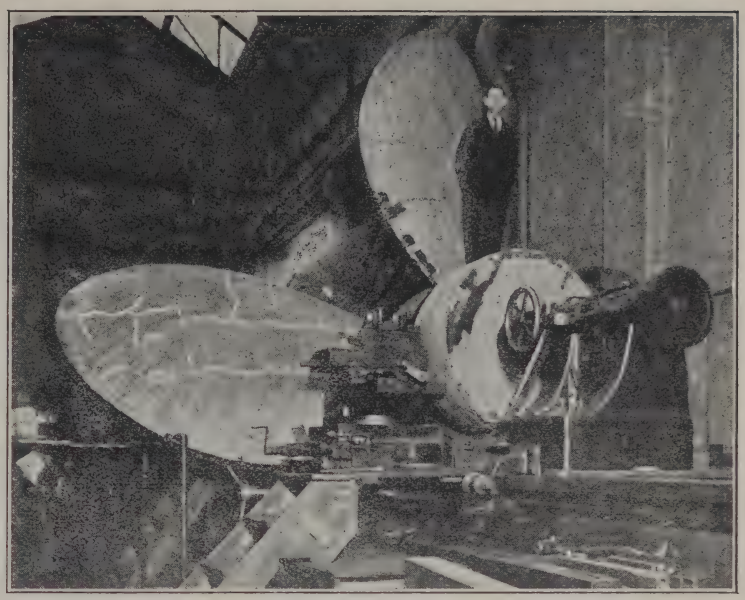
THE ROYAL MAIL MOTOR-SHIP "ALCANTARA"
This ship is propelled by a combination of Diesel engines, electric generators and electric motors

that a correspondingly large number of "spares" must be carried on board, to replace any parts that may fail during a voyage.

As previously mentioned, the White Star *Britannic* is the world's biggest motor-ship, and some figures as to her Diesel engines are of great interest. They are of the four-stroke type, in two "blocks" of ten cylinders each. In one normal day the consumption of fuel oil is 80 tons, which will turn each propeller roughly 140,000 times, while each piston travels a distance of 280 miles. Every one of the inlet, exhaust and fuel valves functions about 70,000 times a day. Thirteen thousand tons of fresh water are circulated through the jackets and cylinder covers for cooling purposes. No heat is thrown to waste, as even the exhaust gases are used for firing boilers which produce the steam used in various auxiliaries on board.

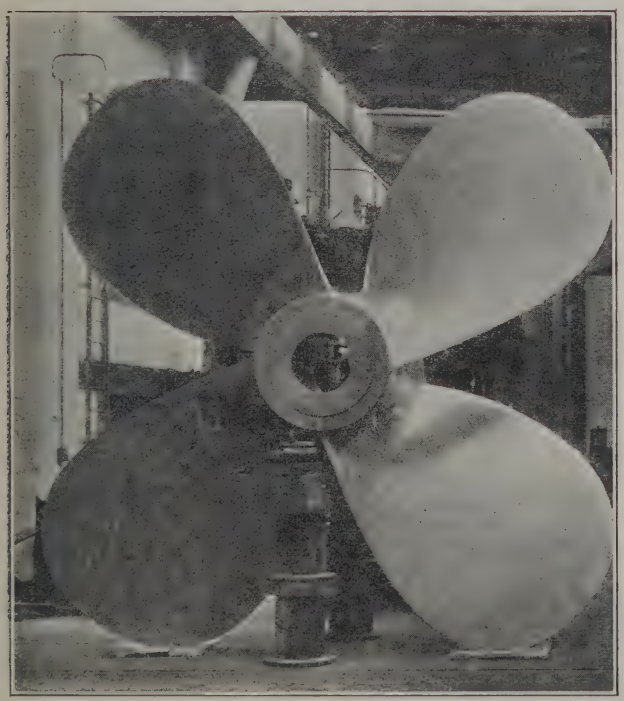
Yet another method of propulsion is that which has been adopted on a few large liners, such as the *Alcantara* and *Almanzora* of the

Royal Mail Steam Packet Company. This is Diesel-electric drive. In each of these ships, which are of 22,500 tons, four 4-cylinder sets of Diesel engines drive four 400-kilowatt motor generating sets, from which the current is transmitted to motors on the propeller-shafts. In certain American warships electricity is produced by steam turbines, and used in the same way for driving the ship. Electric drive has many advantages, such as smoothness, noiselessness and freedom from vibration, perfect control of the propulsion, especially in heavy seas, when there is the danger of the propellers lifting out of the water and racing, and very rapid manœuvring of the machinery.



By courtesy] [*J. Stone & Co., Deptford*

BORING THE "BOX" OF A PROPELLER

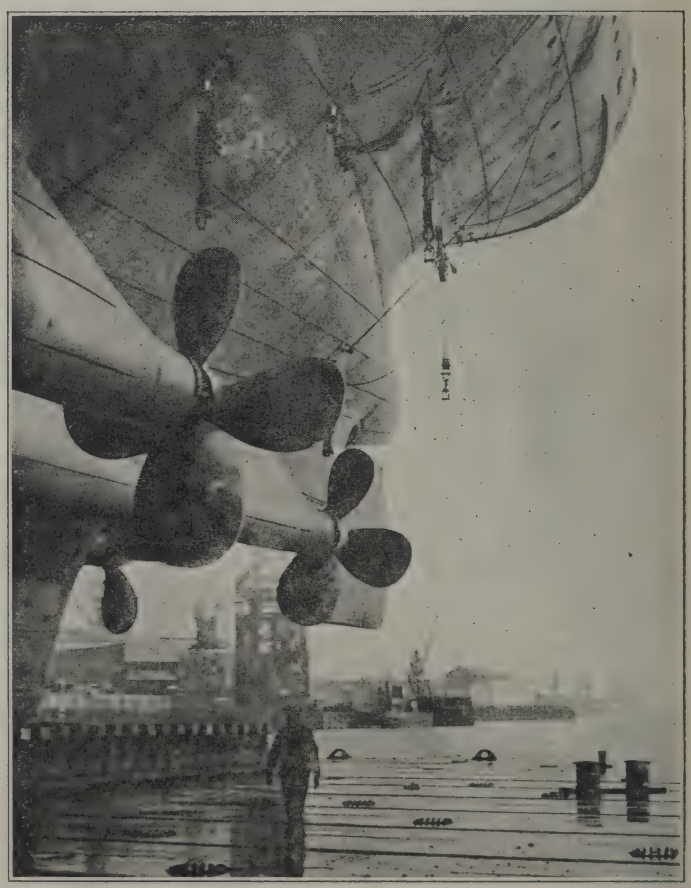


By courtesy] [*J. Stone & Co., Deptford*

ONE OF THE "MAJESTIC'S" FOUR-BLADED PROPELLERS

The propeller-shafts revolve in long tunnels, into which the water is prevented from entering by the tightly-fitting "stuffing-boxes" through which the shafts pass to the screws. Enormous propellers are required for a big modern vessel. Castings are first made, from a special kind of bronze, after which each blade is planed absolutely true to pitch. Opinion is divided as to the merits of three-bladed or four-bladed screws, but the latter are the more widely used.

The great four-bladed propeller of the *Majestic*, which is illustrated here in its finished condition, weighed 30 tons after casting and $15\frac{1}{4}$ tons when ready for mounting; it is $16\frac{1}{2}$ feet in diameter and is designed to turn at 200 revolutions per minute. The world's largest ship employs, as you will see, four such screws to drive her across the Atlantic. Other vessels are triple-screw or twin-screw, according to size and power, and the use of independent engines for each propeller means that the ship is not wholly crippled if she suffers a mishap to one of her engines, shafts or screws.

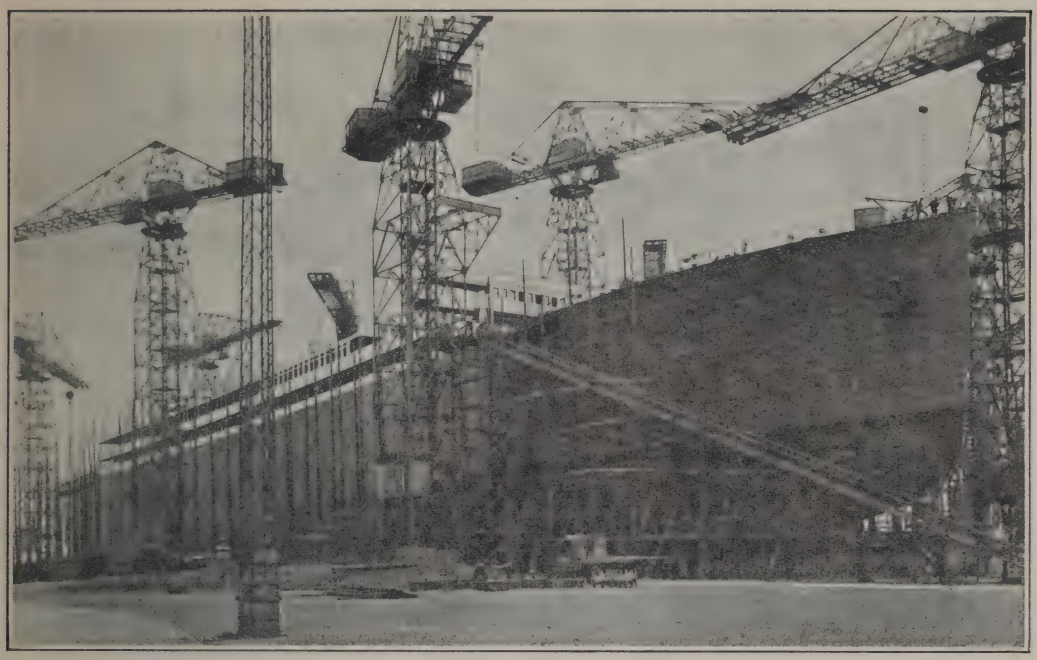


Photo] [*Photopress*

A Striking View of the "Majestic"

Note how the propellers are carried by brackets well clear of the ship's side

AN ELIZABETHAN GALLEON.



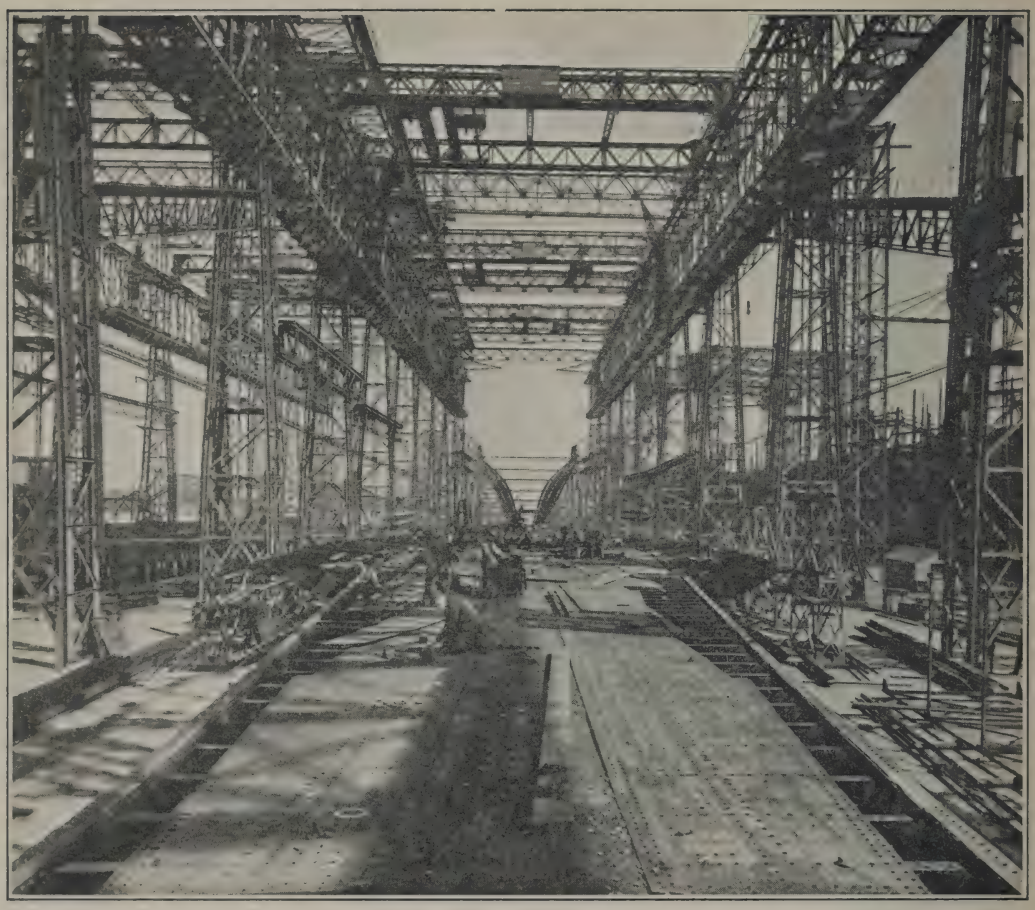
By courtesy] *[White Star Line*

NEARLY READY FOR THE WATER—THE "LAURENTIC" ON THE STOCKS

DESIGNING, BUILDING AND LAUNCHING A SHIP

IT is on paper that the ship begins her career. Before the naval architect who designs her begins to make his plans, he requires to know for exactly what kind of service the vessel is intended. The internal economy of a ship will be varied considerably according to whether she is to carry passengers, or freight, or a combination of both. Long and fast Transatlantic crossings, again, call for designs differing altogether from those of a ship which will make coasting voyages, with shorter runs from port to port.

The chief preliminary plans are three in number: first the "General Arrangement," which shows how the interior of the ship is to be divided up; then the "Midship Section," which is a cross-section of the vessel amidships, and gives details of the steelwork



By courtesy] *[White Star Line*

AN EARLY STAGE OF CONSTRUCTION

The keel of the " Olympic " has here been laid, and the double bottom of the ship is nearly complete. The " tank top " is being riveted on, and on both sides of the ship a large number of the brackets have been erected to carry the frames ; some of the frames on both sides of the stern are in position. Three travelling cranes are seen over the berth

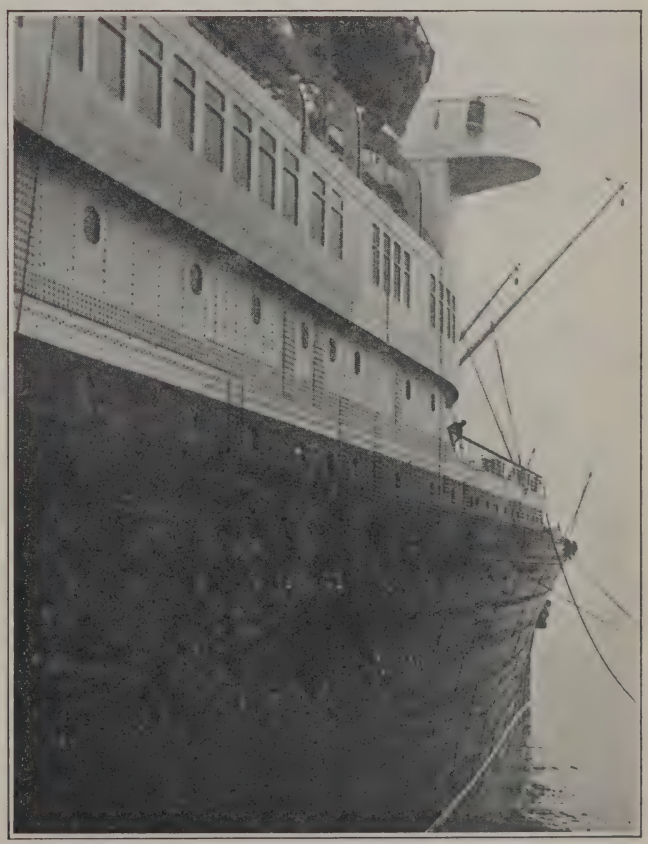
to be used in construction ; and lastly the " Sheer Draught " plans, setting out the constructional lines of the ship as seen broadside on, end on and from above.

When all the myriad details of the design have been settled finally between the owners-to-be and the builders, vast numbers of working drawings must be made in the builders' drawing-office for the use of all those taking part in the construction. In the case of large

liners, models of wood or wax are prepared and floated in experimental tanks, in order to see whether or not the lines of the ship will be the best possible for speed and seaworthiness. The designs are finally corrected by " fairing," which consists in chalking the lines of the vessel full size on the black floor of the mould loft—for all the world like a gigantic blackboard laid flat—and moulding them with long wooden battens.

The mould loft staff are also responsible for preparing templates or patterns, in wood or paper, of each of the innumerable plates which will be used in the structure of the ship, with the exact position shown on them of every single rivet hole, " scrive boards " showing how the various plates and sections are to be bent and bevelled, and many other details. Thousands of pounds may be spent in this way before any actual building work has been begun.

It is in the shipyard that the ship first begins to take shape. Most careful precautions as to the site must first be taken. Water deep enough to float the vessel must be close



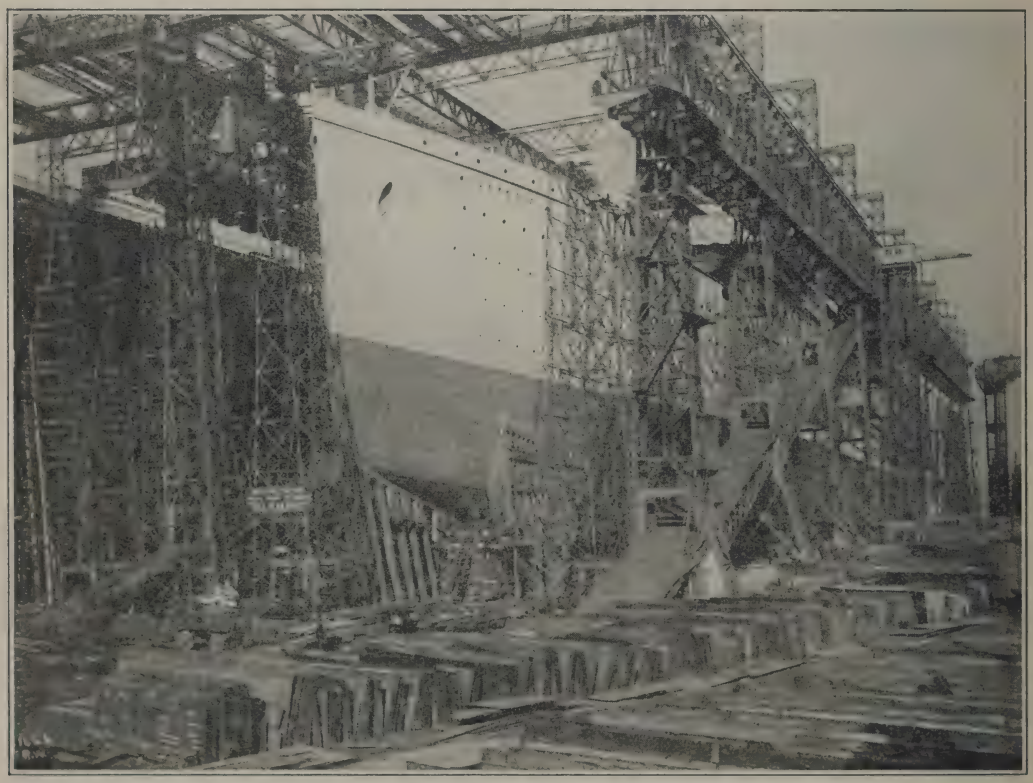
By courtesy [*Norddeutscher Lloyd*

THE STARBOARD SIDE OF THE " EUROPA "

This photograph gives an excellent idea of the plating and riveting of the ship's side. Note also the projecting " cab " at the end of the bridge

by; ground firm enough to support her enormous weight must be underneath ; and the ship must be so supported that, at the right moment, she is able to slide off the one into the other—from the land into her own native element, the sea.

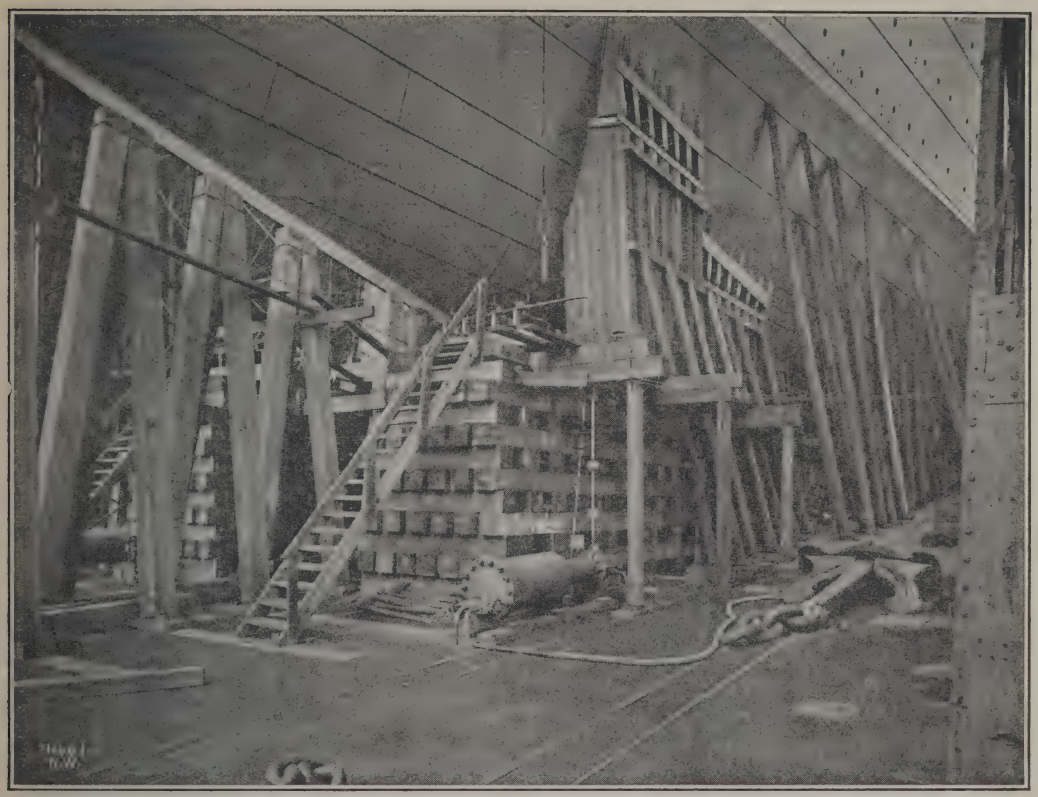
Many smaller ships are built on stocks, out in the open, but the modern berth, in which large vessels are built, is an enormous steel structure, sometimes covered over with a glass roof which enables work to be carried on in all weathers. In the centre of the floor is the slipway, on which are laid the wooden keel-blocks, the whole sloping very gradually towards the water at an angle of about half



By courtesy] [*White Star Line*

THE "OLYMPIC" ON THE STOCKS

This picture gives a most striking impression of the scale on which the construction of a liner is carried out. Note the stocks of steel plates and sections in the foreground ; also the inclined passageway giving access to all levels of the berth



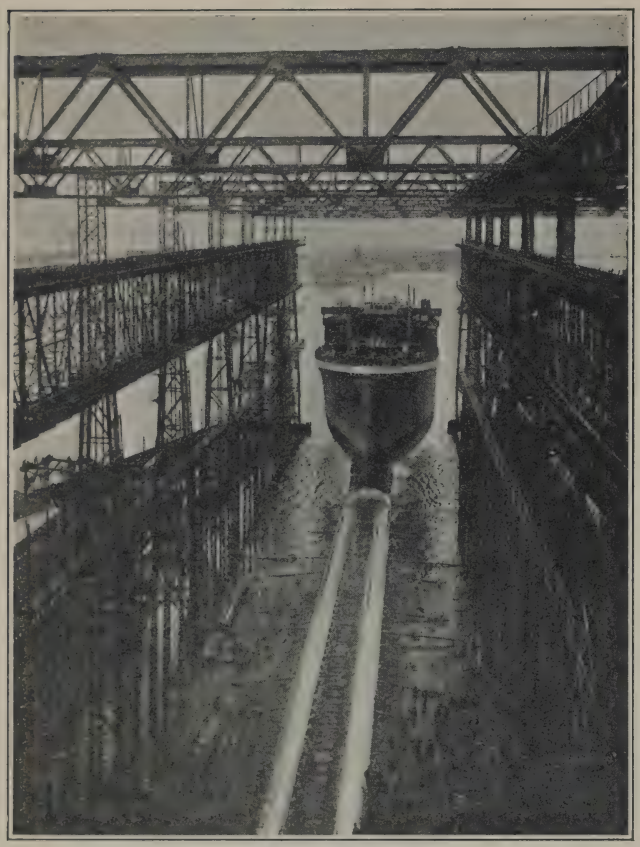
By courtesy] [*White Star Line*

LAUNCHING CRADLE UNDER THE "OLYMPIC'S" BOW

All is now in readiness for launching ; the hydraulic cylinder for releasing the dog-shores is in the foreground

an inch to the foot—sufficient to ensure the launching of the vessel without difficulty when the right moment comes. Spanning the berth overhead are big travelling cranes, which drop into their right positions the heavy steel plates, sections and other parts of the structure, as well as the many weighty details of internal equipment.

First to be laid down is the keel. This is usually a flat steel plate running the whole length of the ship, along her centre-line. The bottom of the ship, which is practically flat, consists of a series of tanks, which carry the water ballast, but also to a large degree protect the ship in the event of her ripping open her bottom upon rocks. Unless the damage so caused is very extensive, the inner



By courtesy] [*White Star Line*

AN EXCITING MOMENT—"THE BRITANNIC" TAKES THE WATER

bottom, or "tank top," as it is called, prevents the sea-water from entering the hold and so sinking the ship. This double bottom is a strong cellular steel structure, built out sideways from the centre keelson, which is erected above the keel, to the curved margin or boundary plates on both sides of the ship, and stiffened at frequent intervals by transverse girders.

The next operation is to erect large steel brackets above the boundary plates and on the outer ends of the transverse girders, all the way down both sides, to which are attached the frames of the ship, curving upwards to the upper deck level like two rows of gigantic ribs. Side "stringers" connect these ribs together in a lengthwise direction, and beams which are to carry the decks connect them transversely across the ship. At the same time the stem and the stern are built into position, the latter being generally a steel forging of immense size and weight, which carries the rudder.

The skeleton is now complete and the time has come to clothe it. Steel plates, all of which have been carefully cut to shape, curved as required, and drilled or punched with their many rivet-holes, are

brought to the berth. Each plate is placed in position ; " heaters," with their portable rivet-heating furnaces, toss the red-hot rivets one by one to the " holders-up," who quickly thrust them through the holes for the attention of the riveters on the other side.

To save time and labour, all riveting is now done by pneumatic or hydraulic machinery. One row or " strake " of plates is riveted at a time from stem to stern, then the next row above it, and so on to the upper deck level. Immediately following the platers come the caulkers, who with their pneumatic tools beat the edges of the plates tightly together, so that the hull may have a smooth surface throughout for the painters, and, much more important, that it may be absolutely watertight.

The rudder, to which reference was made just now, is of tremendous size in a modern liner. On the *Aquitania*, for example, the rudder alone has a weight of 80 tons, and is a steel forging ; the alternative to this is to fashion the rudder from thick steel plate. It hangs by means of its pintles from gudgeon-

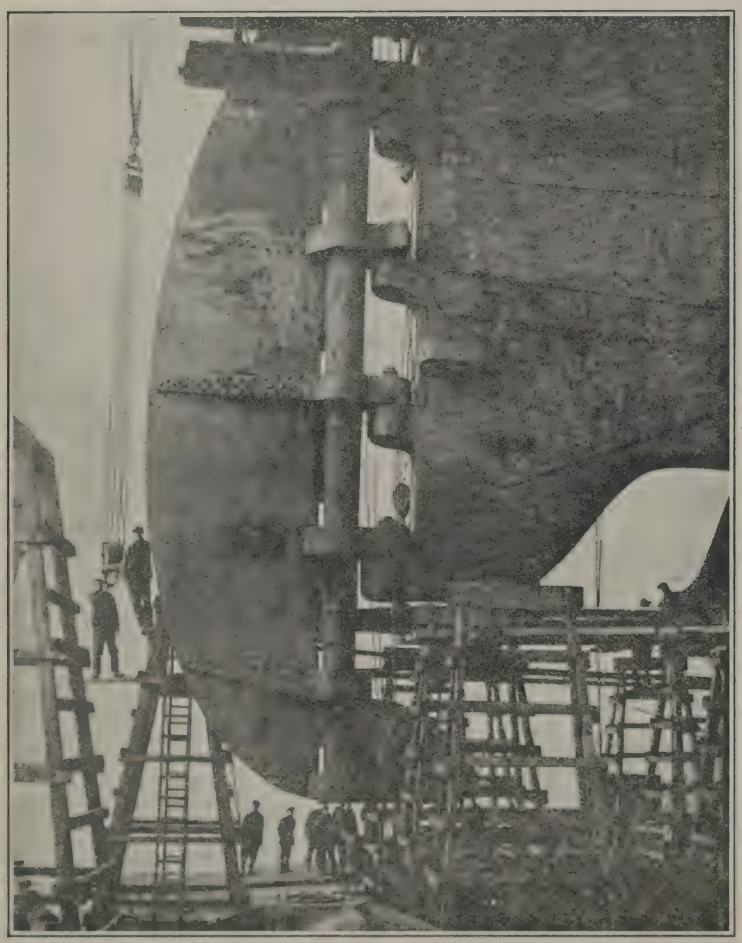
Photo by] *[Sport and General*

WATERBORNE FOR THE FIRST TIME
THE " ULSTER QUEEN " AFTER LAUNCHING AT BELFAST

Note the cables by which the vessel is brought to rest, and the timber of the cradles, etc., presently to be retrieved from the water by the waiting boats

pins on the liner's stern-post, and stops on these gudgeons prevent it from being put over too far in either direction. To move such a weight as this by any ordinary mechanical means would be impossible, and a special steering engine must therefore be provided aft. Rapid and exact control of this engine from the bridge is provided by an ingenious apparatus called the " Telemotor."

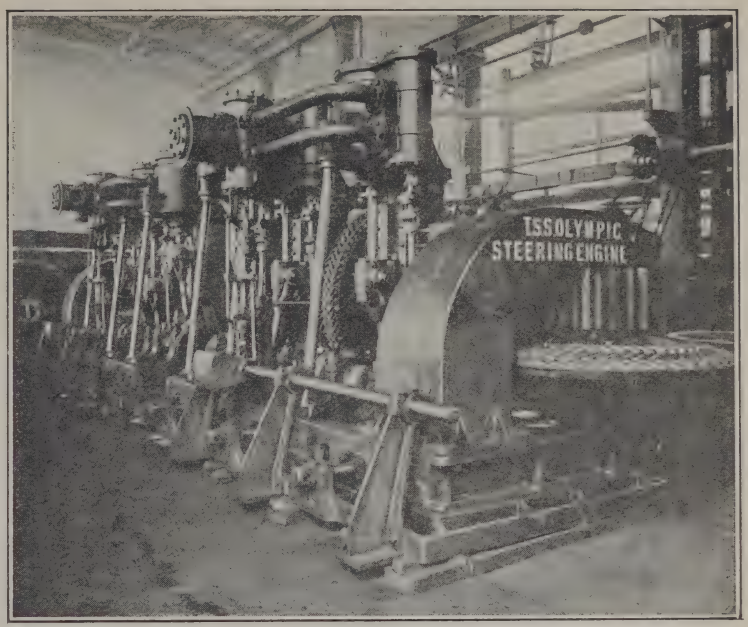
Preparations are now made for the ticklish task of launching the ship—that is, of transferring her weight, which may amount to many thousands of tons, from the slip-way into the water. Details of the actual methods adopted are too complicated to describe at length; the general principle is to lay "sliding ways," well lubricated with grease, on either side of the " standing ways " on which the vessel has been built, to build substantial wooden cradles under her bow and stern to keep her upright, and then one by one to knock out the keel-blocks,



Photo] [*Photopress*

THE MIGHTY RUDDER OF THE " BERENGARIA "

so that only the sliding ways and cradles now support her.

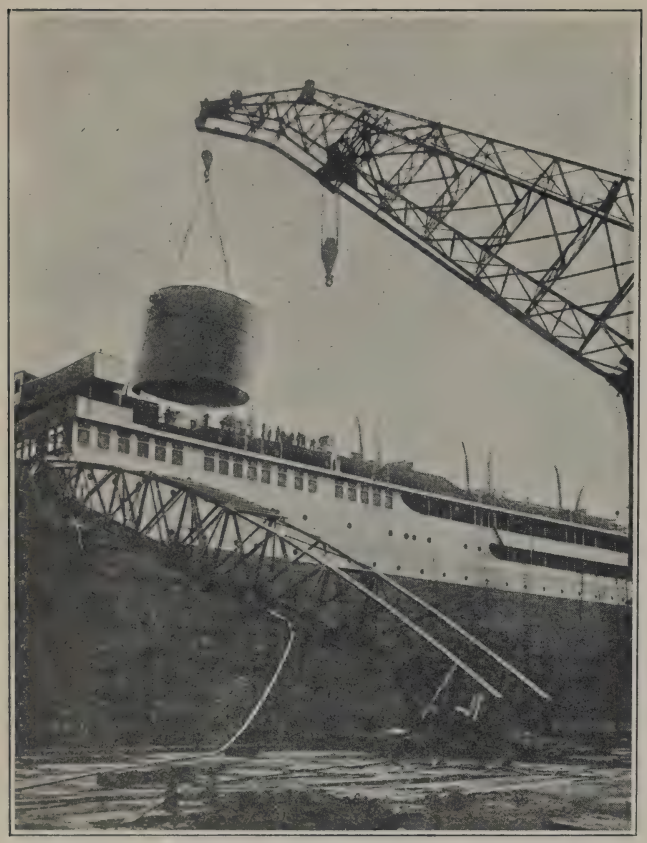


By courtesy] [*White Star Line*

THE STEERING-ENGINE OF THE "OLYMPIC"

A time for launching is usually fixed when the tide is high, so that the ship may reach the water at the earliest possible moment. An excited crowd watches the preliminaries, as the vessel is "christened" by the breaking of a bottle of wine over her bows, and at the same time receives her name. The lady who performs the ceremony cuts through a slender cord; the machinery is put in motion which knocks out all the dog-shores; and if all the preparations have been perfect the mighty mass of steel immediately begins to move. Gracefully she takes the water; chains which have been fixed beforehand gradually begin to pull on her and draw her up gently at the appointed place; and from all around her there are retrieved by waiting boats the timber of the cradles which she has carried with her into the water.

Meanwhile a vast amount of other work has been going on towards the ship's equipment. While the hull is under construction the complicated machinery which is to drive the ship—the reciprocating steam engines or turbines, or Diesel motors, described in another chapter—is being fabricated; the boilers, if the ship is to be propelled by steam, are being assembled; and other details innumerable



By courtesy] *[White Star Line*

SWINGING THE FORWARD FUNNEL ABOARD THE "BRITANNIC"

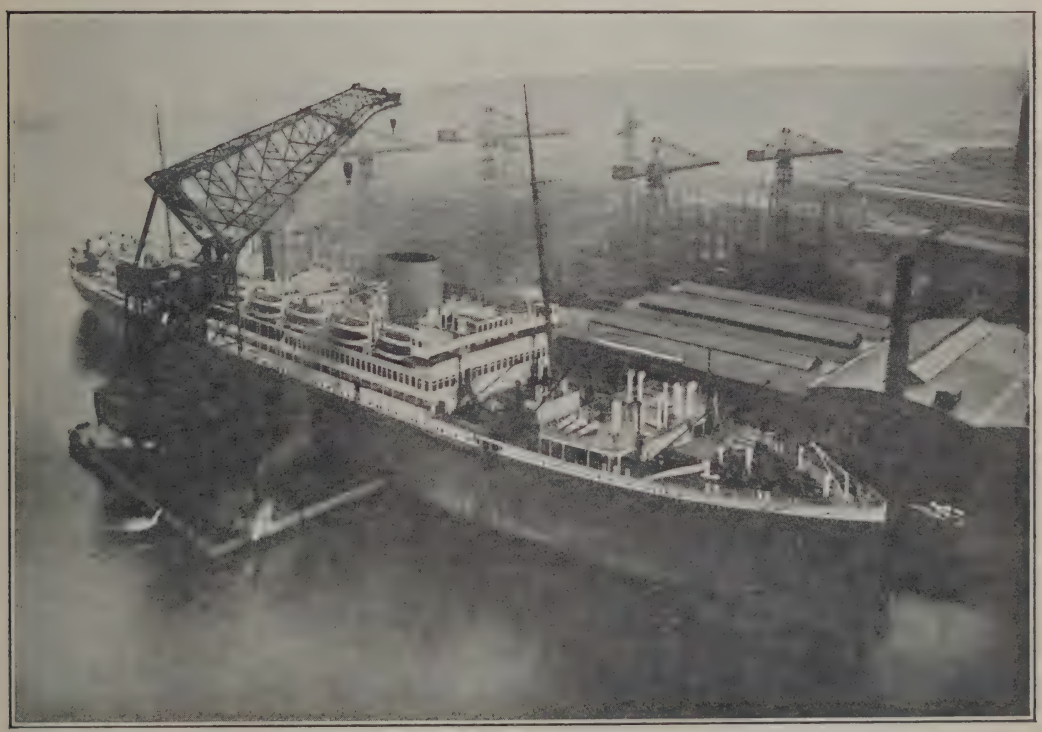
of auxiliary machinery are in course of preparation. Joiners and cabinet makers are hard at work getting ready all the internal woodwork, what time brassworkers and plumbers and many other skilled artisans have in hand the fittings.

Some of their work may be done while the ship is still in her berth, but the bulk of it is carried out after she is in the water. Similarly, most of the heavy machinery is lifted in to the vessel when she is afloat. Cranes of enormous lifting capacity are used for the latter operations, and considerable use is made nowadays of giant floating cranes, such as that shown in one of the illustrations alongside the *Asturias*, at her builders' yard in Belfast.

The marvellous and complex structure is at last complete. If she is a modern ocean liner, her value may be one, two or even several millions sterling of money. Any accident to such a vessel would represent a very serious loss to her owners. Before her career on the high seas begins, therefore, the important question of insurance has to be settled. Of all the organizations which concern themselves with this most important work of marine insurance, the best-known

in the world, the oldest-established, and the most justly famed, is the British corporation known as "Lloyd's." Probably the whole of the steel used in the construction of the ship has been tested and "passed" by Lloyd's surveyors at the various steelworks where it was made; now the whole ship, structure, boilers and machinery, is subjected to a detailed survey.

There are other concerns, both British and foreign, which carry out surveys of ships in a similar way, but it is safe to say that no higher certificate of seaworthiness exists the whole world over than for a vessel to be classed "A1 at Lloyd's." On every voyage made by the ship, the cargo carried is similarly the subject of insurance, and it is not wide of the mark to claim that oversea trade to-day



By courtesy] *[Royal Mail*

FINISHING TOUCHES TO THE "ASTURIAS"

Note the huge floating crane at the side of the vessel, and the hammer-head cranes at the slipway in the background

rests largely on the foundation so well and truly laid by Edward Lloyd in his modest coffee-house as far back as the year 1691.

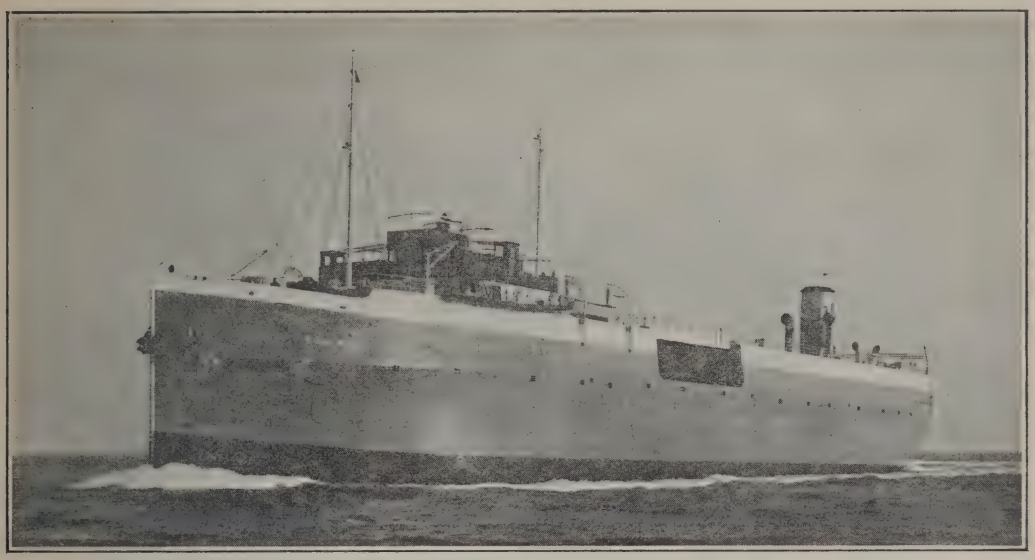
This reference to cargo is a reminder of the precautions which are taken to ensure that no ship shall be loaded beyond the capacity which she can safely carry. Excessive loading would weigh her down too deeply in the water and would thus imperil her safety. In the days before Samuel Plimsoll began the agitation which made his name famous, the lives of crews were risked in ships—" coffin-ships," they were often expressively called—which were overloaded and unseaworthy, but were heavily insured, so that their unscrupulous owners were prepared to fill their pockets even at the expense of human life.

Plimsoll, a Member of Parliament, took this matter so much to heart that at last, in the face of tremendous opposition, he succeeded in getting passed, in 1876, the bill known as the Merchant Shipping Act. Among its provisions is one which insists that every ship shall carry a mark showing the limit of depth to which it may be loaded. In honour of Plimsoll this has ever since been known as " Plimsoll's mark " or the " Plimsoll line."

By courtesy] *[Swan, Hunter, Wigham Richardson*

THE OIL-TANKER " BRITISH HUSSAR "

Note the navigating bridge amidships ; the engines and quarters for the crew are right aft



By courtesy] [*Swan, Hunter, Wigham Richardson*

A Remarkable Craft—The Train-Ferry Steamer "Seatrain"

This British-built vessel maintains a ferry service over the 585-mile route between New Orleans, U.S.A., and Havana, Cuba, and contains three "floors" of railway tracks for carrying wagons between the American and Cuban railways

There is first of all a white circle with a horizontal line drawn across it, sometimes irreverently called "Plimsoll's pancake." This line represents the normal loading of the ship. Above it, on either side of the circle, may be seen the letters "L" and "R," or "B" and "T," according to whether the ship has been measured according to Lloyd's Register or Board of Trade measurement. Then, to the right of the "pancake," there is the "ladder," looking rather like a piece of a white comb set up on end. This shows different limits for fresh water (a higher line than the normal, as fresh water is less buoyant than salt, and also certain to be calmer than the open sea), an Indian summer voyage, a summer voyage, a winter voyage and, at the lowest level, a winter voyage in the North Atlantic, where such stormy conditions may prevail that the ship must be higher out of the water to ride them safely.

It is, of course, the amount of cargo carried by a ship which

By courtesy] *[Hamburg-American Line*

DECK MACHINERY—A LINER'S DERRICKS FOR HANDLING CARGO

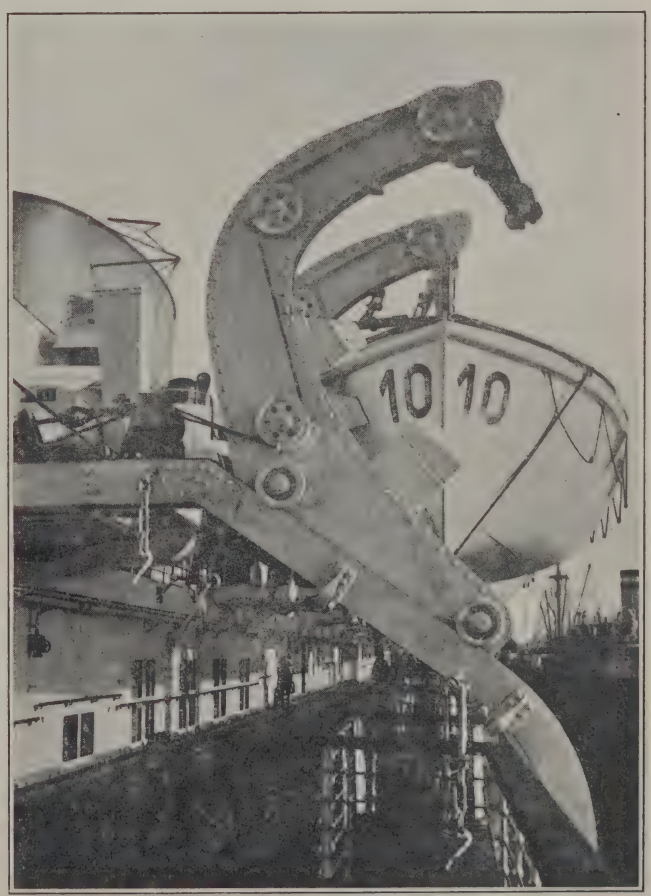
chiefly regulates her depth in the water. But risks would be incurred, on the other hand, if she were too high out of the water, as she would then be topheavy. Arrangements are therefore made to flood the ballast tanks in the double bottom of the ship to as great a degree as may be necessary, when she is carrying insufficient cargo, in order to keep her down to the correct depth in the water. In this condition —or more particularly when she is carrying no cargo at all—a ship is said to be " in ballast."

So far as the largest liners are concerned, it is only the fastest craft on the Transatlantic crossing whose internal space, other than that occupied by engines, boilers and accommodation for the crew, is given up mainly to passengers. It is partly for this reason, and partly because of the cost of maintaining high speed at sea, that the fares charged for the use of such vessels must be high. Many other liners engaged on long-distance routes have a large amount of cargo space, in addition to a limited amount of passenger accommodation. The 21,000-ton liners of the Atlantic Transport Line, for example, carry 370

passengers and 17,000 tons of cargo apiece.

And then there are the vast numbers of ships at sea occupied alone with the carriage of freight, down to the smaller vessels, which, from the nature of their calling, have acquired the humble but expressive title of " tramps." The cargo boat has generally a less number of decks than the passenger liner. Frequently her boilers and engines are right aft, with the funnel above them, giving such steamers their characteristically one-sided outline ; the idea is to devote the maximum possible space to the holds. There is an increasing tendency, too, to dispense with masts in cargo steamers, and to replace them with rows of derricks, or by transverse structures running the length of the ship which look for all the world like a row of goal-posts.

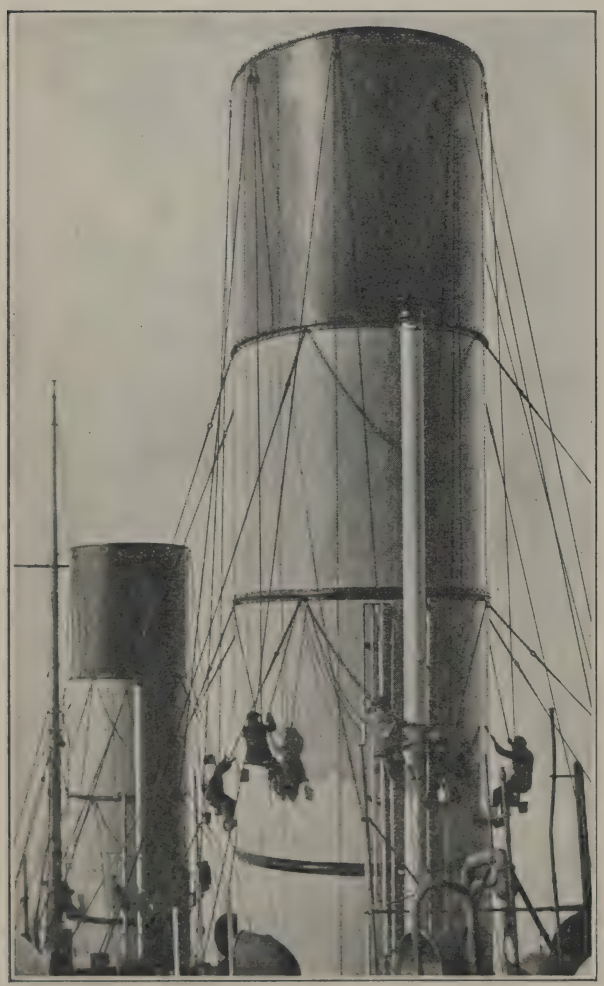
For special descriptions of freight, vessels of special types are built. Carriage of fuels alone employs a large number of ships. " Colliers " are used exclusively for carrying coal, and elaborate coaling plants are in use at the ports nearest to the coalfields, such as



By courtesy] *[Norddeutscher Lloyd*

DECK MACHINERY—LIFEBOAT EQUIPMENT ON THE " EUROPA "

Hull, Immingham, Newport, Cardiff and Swansea, to get the coal stowed in the holds of the ships with a minimum of breakage and in a minimum of time. " Tankers " are a product of the present-day demand for oil as a source of power, and they are being built in constantly-increasing numbers. Internally they consist of one enormous oil storage. The return journeys of such vessels as these to their port of supply must of necessity be " in ballast."



By courtesy] *[Cunard Line*

FASHIONS IN FUNNELS—THE TALL SLENDER FUNNELS OF THE " CARMANIA "

Other ships are designed for the conveyance of food. Large quantities of meat, for example, are brought to Great Britain from New Zealand, Australia and the Argentine Republic. The modern practice is not to carry it frozen during the weeks of the voyage, but " chilled," which keeps it in a considerably better condition. For this purpose the carcases of the animals are packed in special refrigerating chambers, where they are kept at a temperature just above freezing point. One of the modern vessels engaged in this important trade can carry 100,000

By courtesy] [*Royal Mail S.P. Co.*

PAST AND PRESENT AT SEA—SAILS *versus* STEAM.

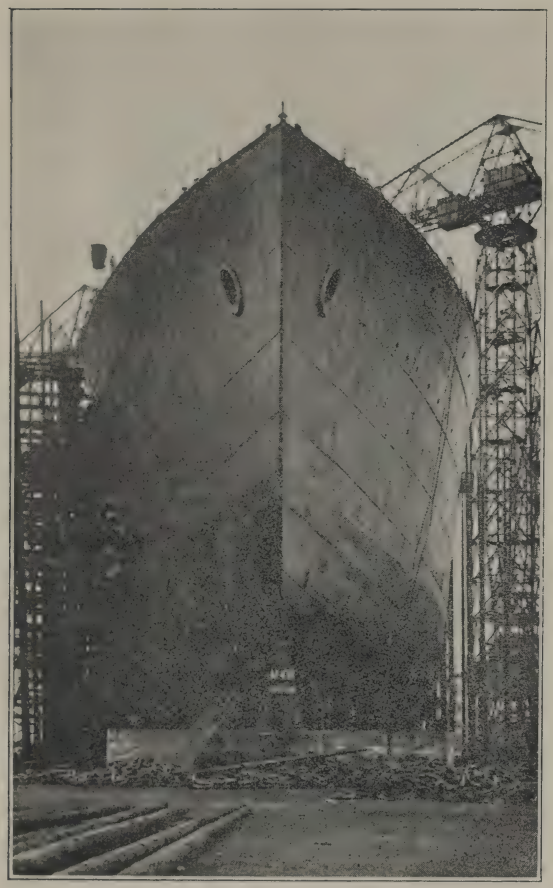
carcases at a time.

The carriage of grain requires other special arrangements, and a customary practice in this case is to provide a hold open from end to end, which is filled with its cargo by means of conveyors, and discharged by the aid of suction appliances. A similar type of ship is used to carry iron ore. Our own native supplies of ore are too limited in quantity and too impure in quality to provide, without considerable additions from the ore-mines of other countries, for our enormous output of iron and steel, and numerous ore-boats are exclusively employed in bringing ore to Great Britain from Spain, India and elsewhere.

By courtesy] [*Norddeutscher Lloyd*

FASHIONS IN FUNNELS—ONE OF THE SQUAT OVAL FUNNELS OF THE "EUROPA"

It is worth while now to devote some space to the external lines of the ship, the evolution in appearance of the passenger liner, in particular, having been one of no small interest. From comparatively early days two funnels were used, in order to provide sufficient draught for the various groups of boilers. Then, as the size and speed of the big liners increased, making more and more demands on steam supply, which in their turn demanded more and more boilers, by degrees a third funnel was added and then a fourth.



By courtesy] [*White Star Line*

BOWS PAST AND PRESENT—THE POINTED STEM OF THE "LAURENTIC"

At the same time there was a tendency more and more to "rake" or slope the masts and funnels, in the latter case with some improvement of draught, as well as giving a great impression of speed. Among the first four-funnelled liners were the *Lusitania*, the *Mauretania*, the *Aquitania* and the *Olympic*.

The result was that in the public mind speed at sea began to be measured by the number of funnels, and there is little doubt that, for a time at least, not a few travellers selected the ship by which they intended to travel in this way! But with the introduction of oil-firing the necessity for so much draught space began to diminish.

There is still a good deal of respect for a handsome external appearance, however, and old customs die hard. Consequently some of the funnels of our modern ocean leviathans have nothing at all to do with furnace draught. The aft funnel of the *Majestic*, for example, is used chiefly to provide ventilation for the boiler and engine rooms, and when the engine room staff get overheated they are provided with means to climb to the top of it! One of the *Britannic's* two funnels houses a smoking-room for the engineers, although it is to be hoped that they do not smoke to as great an extent as an array of boilers!

The *Britannic*, however, is a motorship, and the vessel propelled by Diesel engines requires still less provision made for draught. The motor-vessel, indeed, has introduced some entirely new external lines, with her squat funnels of very large diameter, in place of the tall thin funnels of days gone by. This fashion is now being copied by some of the modern steam vessels, too, such as the German liners *Bremen* and *Europa*. The funnels of these ships are of interest in that they are not circular, but oval, and each outer casing also houses three inner funnels, providing draught for different groups of boilers. One purpose of the oval casings is to lessen wind resistance by this kind of streamlining.

Another unusual feature of the German vessels is the rounded stem, which is quite a novelty, and again has to do with diminishing wind resistance, as also the graceful curve of the bridge and the decks below. All these considerations have doubtless played a part in the speed records made by these two vessels. Note should also be taken of the cruiser stern, which is becoming common nowadays, and affords more protection for the propellers than the older type. So the external appearance

By courtesy] *[Norddeutscher Lloyd*

BOWS PAST AND PRESENT—THE ROUNDED BOW OF THE "EUROPA"

Photo] *[Fox*

THE DEVELOPMENT OF LINE—THE UNION-CASTLE LINER "KENILWORTH CASTLE"

of the liner becomes by gradual degrees more massive, but as our eyes accustom themselves to these changes, we are forced to admit that any loss in beauty is balanced by added majesty.

By courtesy] *[Norddeutscher Lloyd*

THE DEVELOPMENT OF LINE—THE 51,656-TON GERMAN LINER "BREMEN"

By courtesy] [*L.M.S.*

A Miniature Liner of the Irish Sea—The "Duke of Lancaster," Heysham and Belfast Service

CROSSING THE CHANNEL

THERE is no reader of this book who needs to be reminded that our country is an island. All the traffic which passes between Great Britain and other European countries, therefore, must of necessity—until the time, if such a time ever comes, that the Channel Tunnel is bored—make its way by water. At its narrowest, between Dover and Calais, it is but a very brief width of water, 22 miles across, that needs to be spanned. But, narrow or broad, the water intervenes, and some of the most important of the steamer services of Great Britain are those which, by way of the English Channel or the North Sea, link us with the Continent.

The monopoly of the shortest routes to the Continent rests with the Southern Railway. From Dover to Calais or from Folkestone to Boulogne is, in normal weather, a sea journey of but an hour to 75 minutes. The boats on these services are responsible for a double

journey each day, and, as all the journeys are made in the daytime, no sleeping accommodation is needed. Such vessels as these carry a very large number of passengers in proportion to their tonnage, and provision must be made for these people to travel on deck, as most of them want to do in fine weather, or in shelter, when the crossing has to be made in rain or heavy seas. A small number of private cabins are provided for those first-class passengers who care to pay extra for them.

The finest ship on the Dover-Calais service is the triple-screw geared turbine S.S. *Canterbury*, 2,912 tons, which was specially built to connect up the famous " Golden Arrow " Pullman trains on both sides of the water, and carries first-class passengers only. In addition to cabins, this steamer has a deck almost entirely enclosed by plate-glass windows, where passengers may sit most comfortably in numbered " alcoves," which can be reserved in advance. The cross-Channel boats on these services are of no great size or speed,

By courtesy] *[Southern Railway*

THE CROSS-CHANNEL LINK IN THE " GOLDEN ARROW " SERVICE TO PARIS—THE 2,912-TON S.S. " CANTERBURY "

a gross tonnage of about 2,400 to 2,900 and a speed of 22 to 24 knots being sufficient to meet all reasonable needs. The most capacious of them are rated to carry 1,400 passengers.

But some of the vessels which run the longer crossing from Newhaven to Dieppe are faster craft, the *Worthing*, for example, being driven by geared turbines which propel her at 25 knots. The crossing of 75 miles in this case is timed to be completed in just over three hours. Some bigger boats, too, are now being introduced by the Belgian Railways between Dover and Ostend, although this crossing of 68 miles is allowed as much as $3\frac{3}{4}$ hours.

The North Sea crossings are made chiefly at night, and here it is the London and North Eastern Railway which chiefly holds the

Cross-Channel Luxury—The Observation Lounge of the "Canterbury"

By courtesy] [*L.N.E.R.*

NORTH SEA LUXURY—THE SMOKING-ROOM OF THE "VIENNA"

field. In the sheltered waters of the River Stour, near Harwich, a busy Continental port has been established by that company at Parkeston Quay, from which there radiate, fanwise, a whole series of important Continental steamer services. Of these the oldest-established is that to Holland, once run up the Dutch River Maas to Rotterdam, but now terminating at the coastal port known as the Hook of Holland. Then there is the nightly Antwerp service, travelling right up the River Scheldt to the Belgian port of Antwerp ; a nightly service in summer to Zeebrugge, for the benefit of holiday-makers to and from Ostend, Heyst, Knocke and other favourite resorts on the Belgian coast ; yet another nightly service, run by a Danish shipping company, to Esbjerg, in Denmark ; and a day

By courtesy of

THREE CENTURIES OF OCEAN TRANSPORT: THE "MAYFLOWER" (1620), THE FIRS

[*Cunard S.S. Co.*

CUNARDER "BRITANNIA" (1840), AND THE GIANT "AQUITANIA" OF TO-DAY.

By courtesy] [*L.N.E.R.*

A Railway-Owned North Sea Port—Parkeston Quay

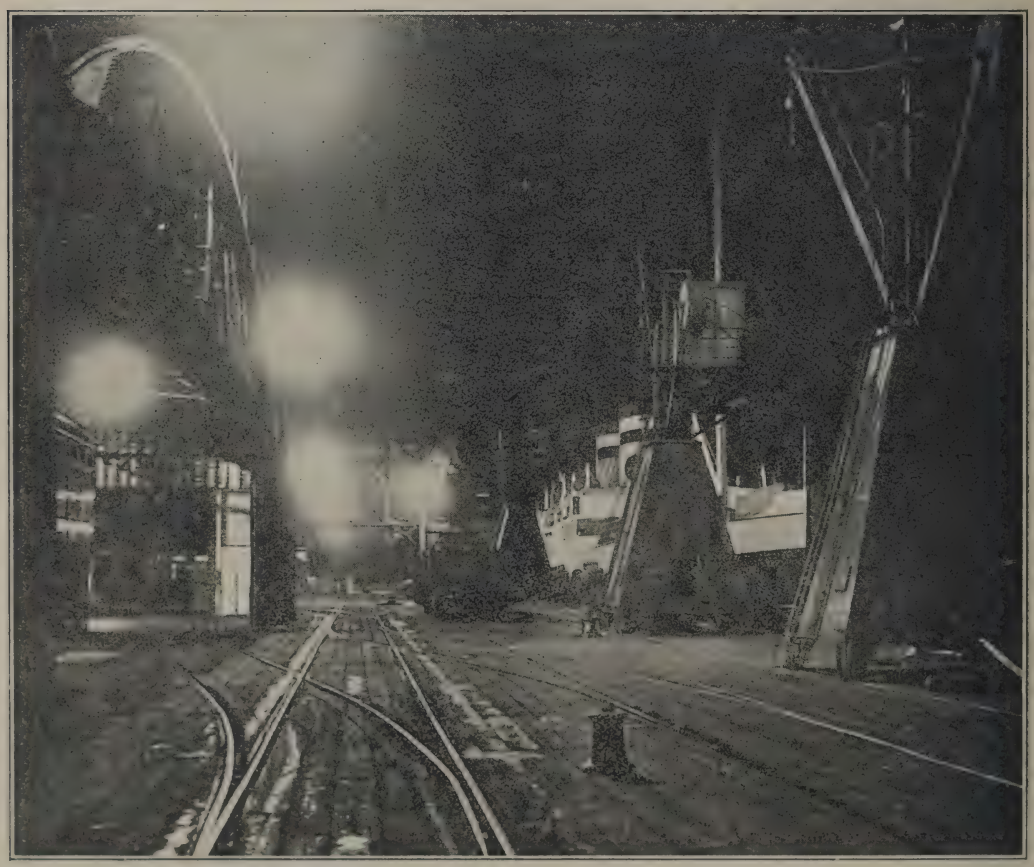
In line are seen the S.S. "Amsterdam," on the Harwich—Hook of Holland service, and then the steamers for Antwerp, Esbjerg, Flushing and Zeebrugge

service, by the Zeeland Steamship Company, to and from Flushing, on one of the Dutch islands at the mouth of the Scheldt. Connecting express trains are run from Hook of Holland, Flushing and Esbjerg to the great cities all over Northern Europe.

The advantage of these night crossings is that passengers can have a whole day in London, then travel down comfortably and quickly in the evening to Parkeston Quay, where they board the steamers at about ten o'clock at night, and, sleeping on the way over—the crossing takes about $7\frac{1}{2}$ hours for the 106 miles to the Hook and

10 hours for the 135 miles to Antwerp—land on the other side, refreshed and ready for another day, first thing in the morning. In order to provide ample sleeping accommodation, the London and North Eastern Railway has built a fleet of what are, in reality, miniature liners.

The latest of the "Hook" boats—the *Prague*, *Amsterdam* and *Vienna*—are 4,218-ton vessels, steaming at 21 knots. They are 351 feet long and 50 feet in the beam, and each of them can carry 716 passengers. The photograph opposite will give you some idea of their beautiful first-class cabins, with such luxuries as hot and

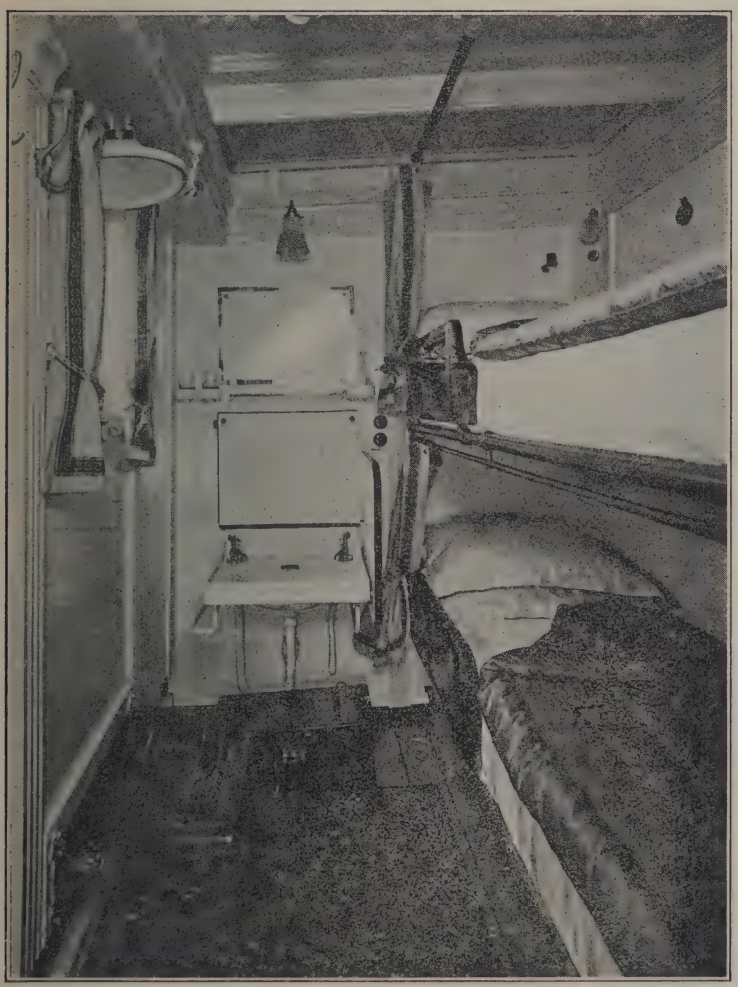


By courtesy] [*L.N.E.R.*

PARKESTON QUAY BY NIGHT

cold running water, brilliant lighting and every comfort conceivable. A considerable amount of cargo is also carried by these boats, and, in addition, special cargo services are run from Parkeston Quay to Rotterdam, Calais and other Continental ports.

The London, Midland and Scottish Railway has not its own steamers to the Continent, though it provides the English connections with an important line of steamers worked by a Continental company between Tilbury and the French port of Dunkerque. On the west side of Great Britain, however, the L.M.S. has some very important interests on the sea, as it is responsible for working the major part of the traffic to and from Ireland. Luxurious steamers are run, both by day and night, between Holyhead and Kingstown, or Dun Laoghaire, as the Irish now call it, close to Dublin,



By courtesy] [*L.N.E.R.*

ON A CROSS-CHANNEL "LINER" OF TO-DAY—A TWO-BERTH CABIN OF THE "VIENNA"
HARWICH—HOOK OF HOLLAND SERVICE

By courtesy] [*Southern Railway*

ON THE CHANNEL ISLANDS SERVICE—THE "ISLE OF GUERNSEY"

and even finer boats ply nightly between Heysham, in Lancashire, and the great city of Belfast.

A more southerly service across the Irish Sea is run by the Great Western Railway, between Fishguard, in the south-west of Wales, and Rosslare, in the extreme south-east of Ireland. This is the shortest crossing from England (or, strictly, Wales) to Ireland, being only 54 miles, and taking about three hours; from Heysham to Belfast is 123 miles and occupies seven hours, and on this service, as on those from Harwich, comfortable sleeping accommodation is provided for all the passengers. But across the narrow channel separating south-west Scotland from north-east Ireland there is a crossing of only 35 miles between Stranraer and Larne; this also is worked by L.M.S. steamers, and only two-thirds of the distance is in open sea.

To complete the railway catalogue, there are the various services

By courtesy] [*G.W.R.*

"ST. PATRICK" FOR IRELAND—ONE OF THE FINE STEAMERS ON THE FISHGUARD—ROSSLARE ROUTE

run by the Southern Railway from Southampton to the Channel Islands of Jersey and Guernsey, to the French port of Havre, and in the summer to St. Malo and Caen as well. The Great Western Railway shares in serving the Channel Islands, running some fine boats to and from Weymouth; in the winter the two companies run their ships day and day about, but in the height of the summer the Southern Railway runs the night steamers in each direction, and the Great Western is responsible for the day boats.

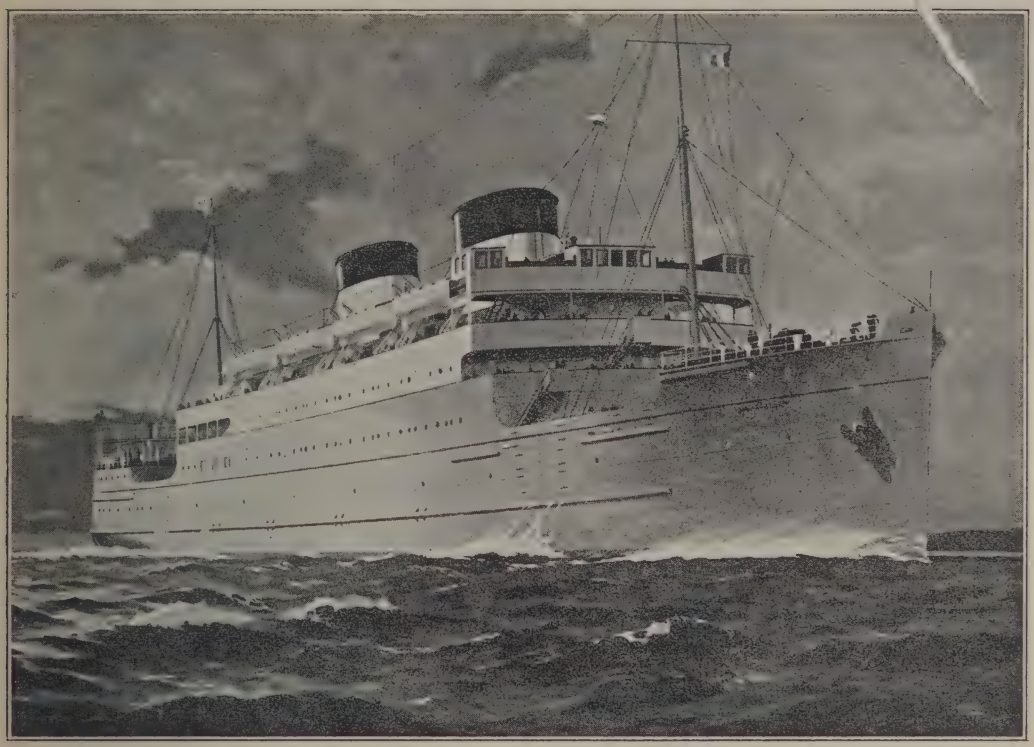
With all these activities, our British railways are quite extensive shipowners. The Southern Railway has in all 43 sea-going steamers, of which 10 are over 2,000 tons and 15 more are over 1,000 tons gross. The L.M.S. beats this with 43 vessels, six of over 3,000 tons and 22 mostly just over 1,000 tons. It is the L.N.E.R. which lays claim to the biggest ships, however, the *Vienna*, *Amsterdam* and *Prague* being each of 4,218 tons, while there are three more L.N.E.R. vessels of all but 3,000 tons, and three further of roughly 2,500 tons,

all turbine ships ; and out of 23 ships owned by this railway only two are of less than 1,000 tons gross. The Great Western Railway, with no Continental services, can manage with eight sea-going steamers of 1,225 to 2,500 tons.

Before we leave the cross-Channel services, there is one remarkable

By courtesy] [*L.N.E.R.*

A Remarkable Cross-Channel Craft—The Train-Ferry Leaving Harwich for Zeebrugge



By courtesy] [*City of Cork Steam Packet Co.*

A Striking Modern Channel Liner—The "Innisfallen," on the Fishguard—Cork Service

cargo service connecting this country with the Continent which deserves mention. The vessels used have no holds, as cargo is not transferred from railway wagons into their interiors before they leave port, nor is there any need for cranes to lift the merchandise from the ship to the shore on arrival at destination; for the railway wagons containing the cargo are run bodily on to these singular craft, carried across the water, and run off on to the lines on the opposite side, without any handling whatsoever.

The "train-ferry," as it is called, runs into and out of a well-protected berth, where her stern is connected with the quay by a hinged bridge, which is arranged to rise and fall with the tide. Railway tracks are laid across this bridge, joining the lines on the quay with tracks which have been laid along the ship from one end

to the other. Across the bridge the wagons are pushed by shunting engines on to the ferry-steamer, where they are securely shackled for their sea journey ; on arrival at the other side the shackles are undone and the wagons run off on to the railway again.

The advantage is that all the costs of handling the freight from train to ship, and from ship back to train, are wiped out, that much time is saved, and also that the risk of breakage of fragile goods is greatly reduced. It is obvious that the gauge, or distance between the two rails of a railway track, must be the same at both sides of the sea crossing, to allow of this being done. The particular train-ferry to which reference has been made is that which runs nightly from Harwich, in Essex, across to Zeebrugge, in Belgium ; it is capable of carrying 56 wagons on every trip. This is the only ferry service worked in connection with British railways, but many similar train-ferries, in most cases carrying passenger trains as well as freight trains, may be found in other parts of the world.

By courtesy] [*L.N.E.R.*

AN ADMIRING DUTCH SCRUTINY—THE NEW HOOK OF HOLLAND S.S. "AMSTERDAM" ON SHOW AT ROTTERDAM

THE FAMOUS BATTLE-CRUISER "RENOWN"

WONDER-SHIPS OF THE NAVY

[*All photographs in this chapter by Fox Photos, except as otherwise noted*]

TO do more than to review the principal types of craft which go to make up the "sure shield" on which our great Empire has depended for so long past is difficult in but one single chapter. But for the marvellous work accomplished by the British Navy in the Great War, keeping the enemy fleets at bay, protecting the transports carrying troops and munitions to the fighting fronts, and keeping open the routes along which convoys of ships were assuring our food supply, history might have been written very differently.

We begin with the battleship. This is the mainstay of the Navy, the most important of all its surface ships—a ship designed to give and receive the hardest of all blows in naval warfare. It is classed

By courtesy] [*L.N.E.R.*

A Modern Battleship—A Striking Stern View of H.M.S. "Nelson"

chiefly according to the size of the guns that are carried. With every increase in the bore and length of the gun, there is a corresponding increase in range, so that a ship mounting, say, 14-inch guns can outrange and destroy by gunfire a ship carrying only 12-inch guns, while the latter is still too far distant for her shells to reach her attacker. This was the secret of the British success at the Battle of the Falkland Islands in 1914, when the battle-cruisers *Invincible* and *Inflexible*, which had been dispatched with the utmost secrecy to the South Atlantic, brought about the destruction of the German Pacific fleet; the British vessels carried 12-inch guns and steamed at 26 knots, whereas none of the German cruisers mounted bigger

than 8-inch guns, nor were capable of over 24 knots.

Naval guns have gradually increased in bore to the present maximum of 16 inches, and of these our latest battleships—*Nelson* and *Rodney*—carry nine apiece, arranged in three triple mountings. With guns of this type a battle can be carried on at a range of 11 or 12 miles and more, and the shell fired is of over one ton in weight. The mountings in which the guns are carried are heavily protected by armour, and are capable of rotation, so that they may fire in all directions. In addition to the big guns, each battleship carries a variety of smaller guns for conducting minor operations. These two remarkable vessels cost £6,000,000 each, and can steam at 23 knots.

A vital feature in battleship design is the armour, which is provided to protect the ship, as far as possible, from shell-fire. This armour is a special variety of steel-plate, usually 13 inches or more thick, to withstand

THE FLEET AT SEA—BATTLESHIPS STEAMING IN "LINE AHEAD"

the enormous explosive force expended by large shells on impact. Armour is arranged in a " belt " round the most vulnerable parts of the ship, particularly amidships, and mainly above the water-line. Below the water-line torpedo attack is now provided against by means of " bulges," designed to take the main force of the explosion, and so to protect the hull. Present-day battleship development, the world over, owes much to the famous *Dreadnought* of 1904, a 17,500-ton vessel designed under the direction of the late Admiral Lord Fisher, which was the first " all-big-gun " ship, and was driven by turbines giving a speed of 21 knots.

As guns and shells increased in size and power, so more and more armour has been called for until, with these tremendous increases in weight, it became necessary to sacrifice either speed or armament. In the battleships just described armament has been the main consideration. But shortly after *Dreadnought* had made her appearance, it was decided to introduce a warship which should be a kind

TRIPLE GUN MOUNTINGS ON THE U.S. BATTLESHIP " IDAHO "
The size of the guns is well realised by comparison with their human freight

of compromise between the battleship, with her big guns and heavy armament, and the lightly-armed cruiser, with her high speed. The new type of vessel came to be known as a " battle-cruiser."

THE NAVY'S CEASELESS WATCH—
AN EVENING STUDY OF WARSHIPS ON PATROL DUTY

In the British Navy the two latest and finest examples of battle-cruiser design, built largely as an outcome of the success of *Invincible* and *Inflexible* at the Falkland Islands Battle, are *Repulse* and *Renown*. These magnificent vessels, of 26,500 tons displacement, carry six 15-inch guns and seventeen 4-inch guns, and are designed for a speed of 32 knots; they are protected with side armour 9 inches thick and with bulges against torpedo attack. Another remarkable ship, of later date, is *Hood*, which was designed as a battle-cruiser, but, as a result of lessons learned at the Battle of Jutland, was altered in building so that now she is practically a battleship, though with a battle-cruiser speed of 32 knots, requiring no less than 144,000 horse-

By courtesy] [*L.N.E.R.*

A Light Cruiser—H.M.S. "York"

power for its development. *Hood* carries eight 15-inch guns and twelve 6-inch guns, and is protected by an armour belt 12 inches thick.

Great changes have taken place in the external appearance of the warship during the last two decades. Duplicate masts and numerous funnels, and other deck complications such as the various bridges housing gun and various controls, have by degrees been swept clear. The latest British battleships and battle-cruisers, such as *Nelson*, *Rodney*, *Repulse*, *Renown* and *Hood*, have one funnel and one tripod mast right aft; in front of the funnel is a towering steel structure which houses the navigating bridge and all the controls. The latter are thus quite clear of the thick smoke emitted from the funnels at speed, as so clearly shown in one or two of the pictures in this chapter. The level silhouette of the main deck at the forepart of the ship is broken only by the big gun mountings.

Cruisers are lighter craft, built for the protection of trade routes and to act as "scouts" for the battle-fleet in time of war. But the

German so-called "pocket battleship"—the new *Ersatz Preussen*—is likely to have a tremendous effect on future cruiser construction. Diesel-driven, with machinery of unprecedented lightness, she can travel at 26 knots and carries enough fuel for a 20-knot voyage of 10,000 miles. She is heavily armoured and protected as well.

We now come to the fastest craft of the fleet—the destroyers. Their full name is "torpedo-boat destroyers," and the history of their evolution has been a curious one. It was in 1805 that an American named Fulton first devised a method of sinking ships by means of a "torpedo," which exploded a charge of gunpowder under water against the hull of the vessel attacked. The first of these torpedoes were carried on long poles, or spars, and exploded by a variety of means when they had got near enough to the attacked ship. Various types of torpedoes which could propel themselves were tried later, but it was not until Whitehead in 1864 designed and produced the first Whitehead torpedo that this formidable and justly-dreaded method of attack came into general use.

The employment of torpedoes resulted in the design of special small and fast craft to carry and fire them. In 1877 the British

By courtesy] [*Swan, Hunter, Wigham Richardson*

A Modern Destroyer—H.M.S. "Whitshed"

Government introduced the first real torpedo-boat—a tiny vessel of 34 tons, capable of steaming at 19 knots. By 1895 British torpedo-boats had increased to 130 tons displacement, and a speed of 25 knots, and the newest examples were provided with three 18-inch torpedo-tubes apiece. By 1908 the displacement had grown to 280 tons and the speed to 26 knots, while small guns were also mounted.

But this new menace to the fleet now began to call for the development of warships of sufficient speed and armament to attack and destroy the torpedo-boats before the latter could launch their torpedoes. Designed on the lines of the torpedo-boat itself, but of larger size, higher speed, and now with a substantial armament, the destroyer soon proved that it could not only destroy the torpedo-boat, but could also carry out the work of the torpedo-boat much more effectively than the smaller craft. It was not many years after the first destroyers appeared in 1892, therefore, that the popularity of torpedo-boats began to wane ; to-day they are no longer built.

Meantime the destroyer has grown to a fast and formidable craft. The highest of all speeds at sea have been attained by vessels of this type. Only recently the new French destroyer *Bison* has broken, by steaming at 41·5 knots (47¾ miles per hour), the 41·1-knot record previously held by the same country's destroyer *Verdun*. The latest destroyers, such as the " V " and " W " classes of the British Navy, are of no less than 1,300 tons displacement, rated at 34 to 36 knots, which speed demands propelling machinery—geared steam turbines, in most cases—of 27,000 horse-power. Two sets of triple torpedo-tubes enable six torpedoes, each of 21 inches diameter, to be fired simultaneously ; in addition these vessels carry four guns of 4 inches or 4·7 inches bore, and a 3-inch anti-aircraft gun. To all intents and purposes the destroyer of to-day is a light cruiser of a small and very fast type.

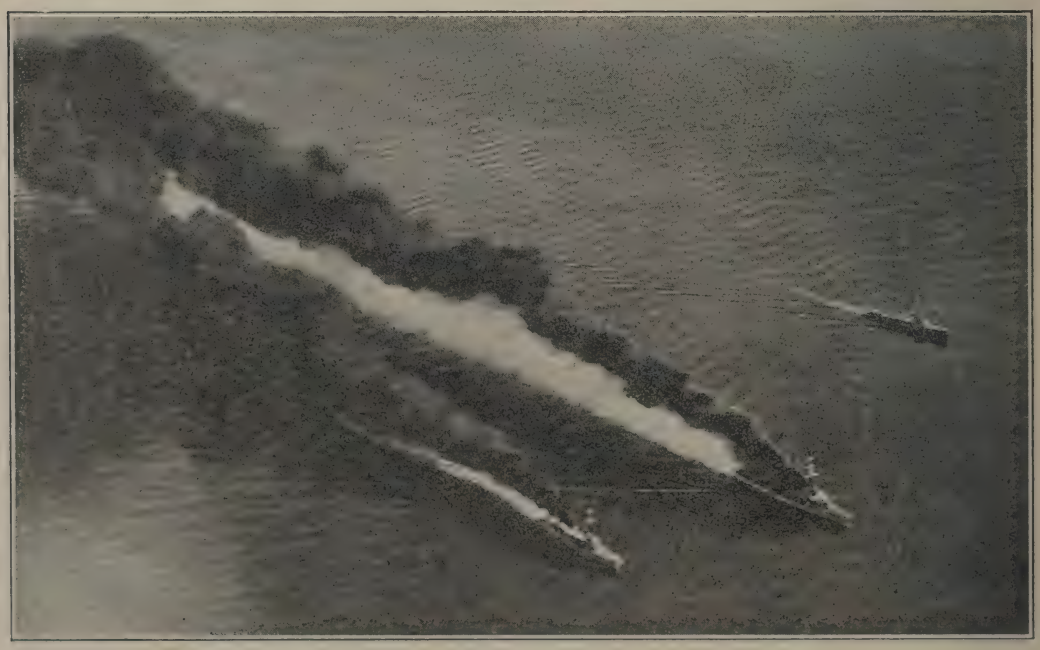
Developing still further out of the destroyer idea there is the modern

By courtesy] [*Swan, Hunter, Wigham Richardson*

FORTY KNOTS—A STRIKING VIEW OF A DESTROYER AT FULL SPEED

" flotilla-leader," which is the senior officer's ship of a division of destroyers. The latest of these vessels in the British Navy are the " Campbell " class—36-knot vessels of 1,800 tons displacement and still more powerful armament than the biggest destroyers. Here again Italy's latest naval surprise—the 5,250-ton " Black Band " cruisers, with 95,000-h.p. engines driving them at 37 knots, and eight 6-inch guns apiece—will prove a serious menace to destroyers. British destroyers did some wonderful work during the Great War, far wider in its scope than that of merely delivering torpedo attacks. They laid smoke screens to hide the bigger ships from the enemy; they protected not only the battle-fleets but also the convoys of merchantmen from submarine attack; they laid mines and covered the work of mine-sweepers, and did all kinds of other useful service.

A word may be said here about the torpedoes, the firing of one of which from a torpedo-tube figures in the fine photograph opposite.

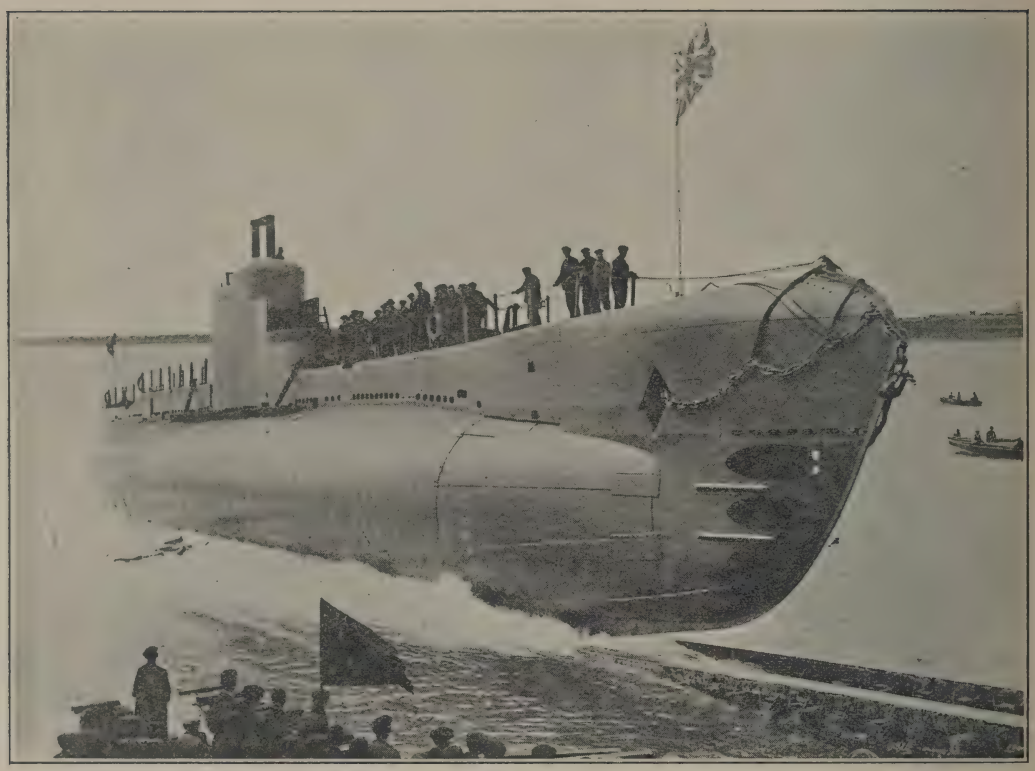


Modern Naval Warfare—Destroyers Laying a Smoke Screen

A Deadly Weapon—Firing a Torpedo

The 21-inch torpedo is a cylinder about 20 feet long. In the head is stored 500 lb. of the deadly explosive "T.N.T.", which is detonated by a "pistol" screwed into the nose. Behind this is a long air-chamber to give the torpedo buoyancy. The rear end is occupied by petrol motor machinery capable of driving the torpedo at 36 miles an hour for four miles or more, with remarkable pendulum and gyroscope devices to control the depth and direction of travel. Torpedoes are discharged from torpedo-tubes, the latest destroyers, as previously mentioned, being fitted with six tubes in sets of three. From these tubes a torpedo is blown by the blast from a discharge of cordite contained in a special chamber at the rear.

One of the greatest menaces to Great Britain in the Great War was the activity of enemy submarines, at first directed against warships proper, but later in unrestricted fashion against merchant vessels. Chiefly by the use of torpedoes, these submarines sank no



LAUNCHING A SUBMARINE

Note the triple torpedo-tubes at the bow, the conning-tower amidships and the bulge which houses the water-ballast tanks

less than 2,639 merchant ships in 1917 and 1,103 in the ten months of 1918 up to the armistice ; but this result was achieved at a cost of 66 submarines sunk in the former year and no less than 88 in the latter, by which time the threat was being effectively countered. The danger of the submarine, of course, lies in the fact that it can cruise completely submerged, only the slender periscope being visible above water, although the periscope is sufficiently accurate in sighting to allow of the aiming of torpedoes when the vessel is in this submerged condition.

Experiments in submarine construction go back for many years. The first effective use of a submarine in naval warfare was probably

in 1864, when the American vessel *Housatonic*, blockading Charleston in the Civil War, was sunk by a primitive submarine craft. But it was not until the beginning of the present century that the submarine came into use as a practical instrument of naval warfare. The submarine is a vessel with a double hull. Within the inner hull are the engines, the stores of torpedoes, and the quarters for the crew. Between this and the outer hull there is a series of water-ballast tanks, which can be filled or pumped empty at will. When they are empty, the buoyancy causes the vessel to rise to the surface; as they are filled she submerges; and the depth of submergence is governed by the amount of water that they contain.

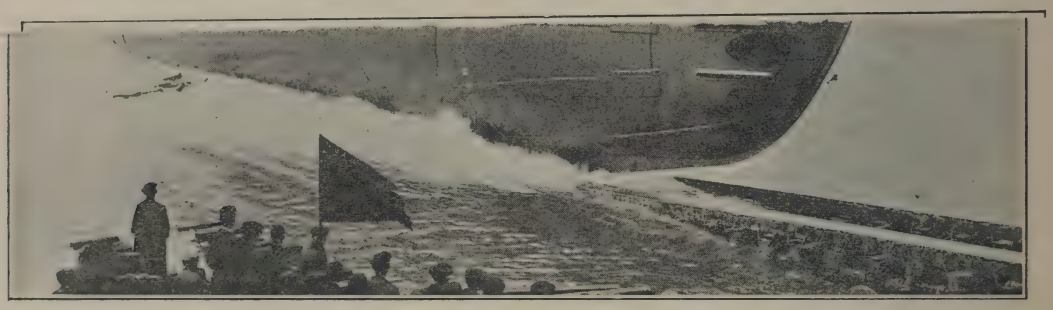
THE "EYES" OF THE FLEET—AN AEROPLANE LANDING ON THE DECK OF H.M. AIRCRAFT-CARRIER "FURIOUS" AFTER A RECONNAISSANCE

surface for as long as possible, of course, only submerging either to attack or to avoid attack. The latest submarines are most formidable craft. *Surcouf*, a French monster, displaces 4,300 tons when submerged, is 394 feet long, is armed with 8-inch guns and 14 torpedo-tubes (all firing simultaneously, if needs be), carries enough fuel for a 12,000-mile cruise on the surface at a moderate speed, and can remain under water for 60 hours! The British "X.1." is but little inferior in size and power.

Another important development of the late war was the extensive use made by the various navies of aircraft. To a certain extent aeroplanes were used for bombing enemy ships and bases, but still more as the "eyes" of the fleet. These aerial activities of the fleet have led to the design and building of some of the strangest craft ever yet seen on the seas. They are known as "aircraft-carriers." The upper deck is one vast flat space from which the aeroplanes take off and on which they land after their reconnaissance flights. On the American aircraft-carrier *Lexington*, illustrated opposite, this deck is 888 feet long by 106 feet broad. In order to keep the

gun, usually of about 4 inches bore. Above the conning-tower is the periscope, which, by means of inclined mirrors carefully fixed and sighted at the top and bottom, gives an exact view inside the submarine of what is going on above the surface, even when the whole vessel is submerged but for the top of this periscope.

When the submarine is cruising on the surface Diesel motor propulsion is employed, but when cruising under water it is necessary to have recourse to electric motors, supplied with current from batteries, reducing speed from the surface speed of 17 to 20 knots to about one-third of this figure. The submarine remains on the

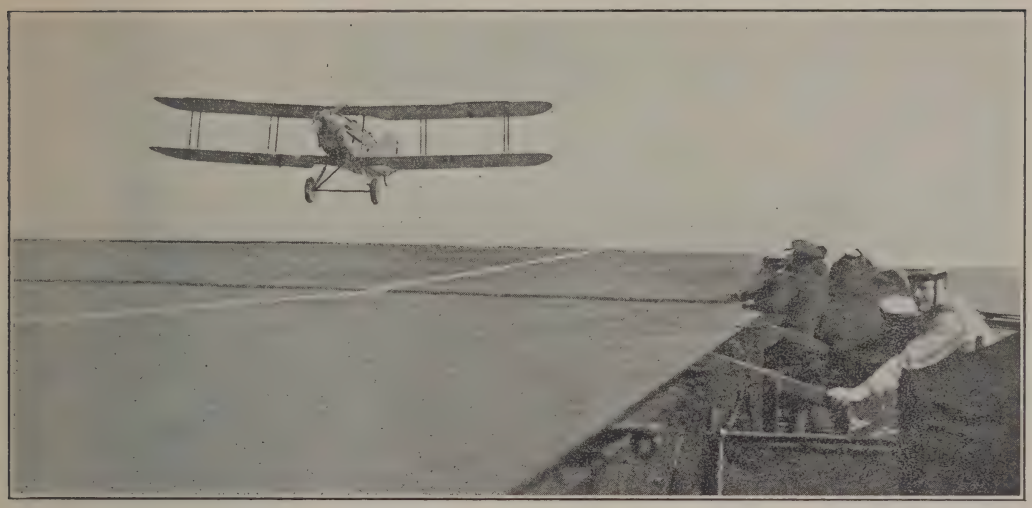


LAUNCHING A SUBMARINE

Note the triple torpedo-tubes at the bow, the conning-tower amidships and the bulge which houses the water-ballast tanks

less than 2,639 merchant ships in 1917 and 1,103 in the ten months of 1918 up to the armistice ; but this result was achieved at a cost of 66 submarines sunk in the former year and no less than 88 in the latter, by which time the threat was being effectively countered. The danger of the submarine, of course, lies in the fact that it can cruise completely submerged, only the slender periscope being visible above water, although the periscope is sufficiently accurate in sighting to allow of the aiming of torpedoes when the vessel is in this submerged condition.

Experiments in submarine construction go back for many years. The first effective use of a submarine in naval warfare was probably



THE "EYES" OF THE FLEET—AN AEROPLANE LANDING ON THE DECK OF H.M. AIRCRAFT-CARRIER "FURIOUS" AFTER A RECONNAISSANCE

surface for as long as possible, of course, only submerging either to attack or to avoid attack. The latest submarines are most formidable craft. *Surcouf*, a French monster, displaces 4,300 tons when submerged, is 394 feet long, is armed with 8-inch guns and 14 torpedo-tubes (all firing simultaneously, if needs be), carries enough fuel for a 12,000-mile cruise on the surface at a moderate speed, and can remain under water for 60 hours! The British "X.1." is but little inferior in size and power.

Another important development of the late war was the extensive use made by the various navies of aircraft. To a certain extent aeroplanes were used for bombing enemy ships and bases, but still more as the "eyes" of the fleet. These aerial activities of the fleet have led to the design and building of some of the strangest craft ever yet seen on the seas. They are known as "aircraft-carriers." The upper deck is one vast flat space from which the aeroplanes take off and on which they land after their reconnaissance flights. On the American aircraft-carrier *Lexington*, illustrated opposite, this deck is 888 feet long by 106 feet broad. In order to keep the

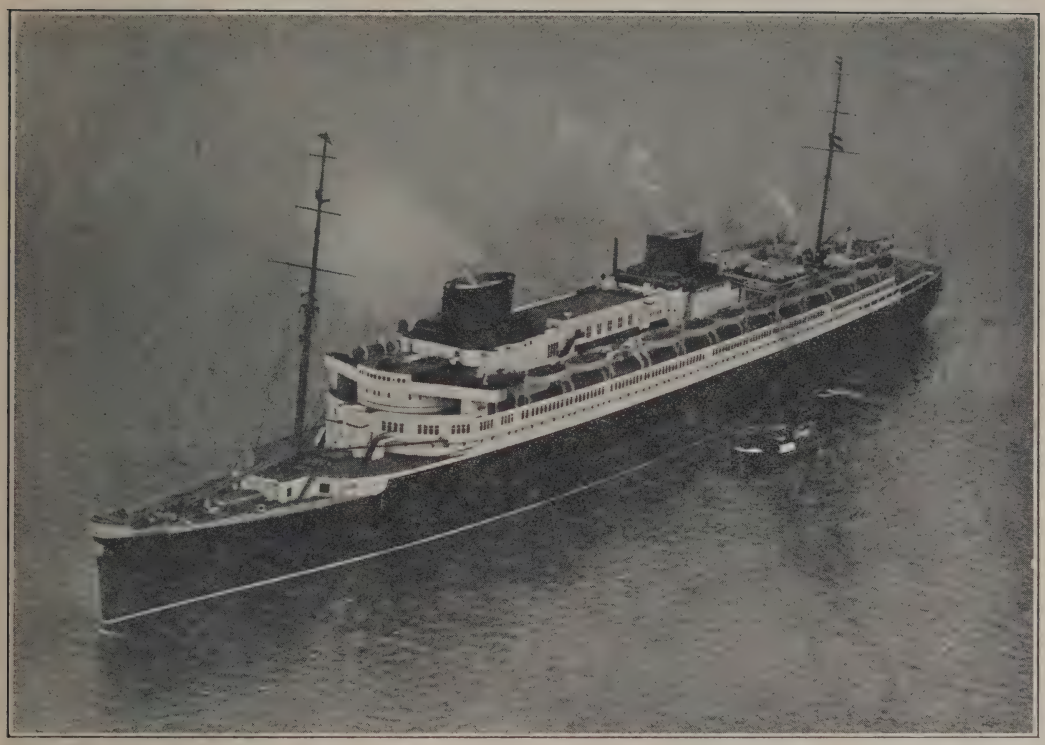
FLAGSHIP OF THE MEDITERRANEAN FLEET—H.M.S. "WARSPITE"
The great battleship is leaving Malta for Portsmouth harbour, where the Commander-in-Chief is to haul down his flag on promotion to the office of First Sea Lord. Note the control tower of the ship and the bulge on the water-line for protection against torpedoes

deck space absolutely clear, the funnel, the mast, the guns and the control tower are pushed to an "island" at the extreme starboard side of the deck. Below the deck are hangars in which the aeroplanes are stored. The *Lexington* has a capacity for 72 planes, a displacement tonnage of 33,000, and can steam at 34 knots; this vessel and the *Saratoga* were originally building as battle-cruisers, but were converted to aircraft-carriers, of which they are the biggest examples in the world.

The aircraft-carrier must always be steaming into the wind as the aeroplanes, which approach from behind the ship, drop down to alight; the real and the artificial breeze together assist the aeroplanes to land or to take off in a minimum of space. At the same time the speed enables the aircraft-carrier to keep up with the rest of the fleet, or to retreat rapidly if attacked by superior forces.

By courtesy] *[White Star Line*

A FLOATING HOTEL OF TO-DAY.
CORRIDOR AND PALM LOUNGE ON S.S. "HOMERIC."



By courtesy] [*Norddeutscher Lloyd, Bremen*

SISTER-SHIP TO THE "BREMEN"—THE 51,656-TON "EUROPA"

FLOATING TOWNS OF TO-DAY

TO see the interior of a modern ocean liner is an experience not to be missed. If you have not yet done so, you can have but little idea of the vast size and the palatial equipment of one of these marine mammoths. Indeed, when you get on board, and are conducted through dining saloons larger and loftier than those of the biggest hotels on shore, through palm lounges and verandah cafés, through swimming baths and gymnasiums, through bedrooms vying in comfort with the most luxurious on land; or when you descend to the depths of the ship by means of swift electric lifts and find yourself in boiler rooms covering five acres of floor space or amidst a labyrinth of machinery developing up to one hundred

By courtesy] *[Orient Line*

A Luxurious Bedroom of the "Orford"

thousand horse-power; you may well be excused if you fail to realize that you are afloat at all!

The total length of the largest vessels of to-day is from 900 to 960 feet—that is, between one-sixth and one-fifth of a mile. A couple of turns round the upper deck of a liner of this size, from bow to stern and back, provides the passenger with a walk of a mile straightaway. The "beam," or width, of one of these huge craft is about one hundred feet, or slightly less, and the depth, from the upper boat deck to the keel, a little over 90 feet. This last figure amply explains why lifts are necessary to give rapid communication between the various decks of the ship. Between the boat deck and the hold deck, just above the ship's bottom, where the cargo is stored, a vessel like the Cunarder *Aquitania* has eight decks, numbered from "A" to "H," and so corresponds to a building of ten stories. She is 92½ feet in depth from boat deck to keel, but the tops of her funnels are 164 feet above the keel, and her mastheads are 220 feet above the keel.

You will doubtless have noticed that a ship is generally described in terms of "tonnage," and that advertisements of the large liners

lay a good deal of emphasis on this weight. It is obvious that, the bigger the ship, so much the smoother the ocean passage is likely to be, no matter in what weather it may be made.

There are various ways of measuring the tonnage of a ship. " Displacement " is the weight of water displaced by the vessel as she floats. " Gross " tonnage, reckoned at one ton to every 100 cubic feet of space, indicates the weight of cargo which could be carried if every enclosed space on board were filled to its utmost capacity. " Net " tonnage, on which dock and harbour dues are calculated, is based on the gross tons less the space taken up by engines, boilers, stores and accommodation for the crew. The Americans, by decking over certain open spaces on their great liner *Leviathan*, were able in this way to raise her gross tonnage from 54,292 to 59,957 tons, and so, they argued, she became the biggest liner in the world. But the

By courtesy] *[Cunard Line*

THE GRILL-ROOM OF THE " AQUITANIA "

British ship *Majestic*, rated on similar gross tonnage calculations at 56,620 tons, is 6 feet longer and 1 foot deeper than the *Leviathan;* furthermore, the *Majestic* displaces 64,000 tons to the *Leviathan's* 63,100 tons. It is hardly open to question, therefore, that the *Majestic* remains " Queen of the Seas."

While records in the matter of size are thus sought for, there is equal competition in the realm of speed. The history of the competition for the " Blue Riband " of the Atlantic has been a very exciting one. In the closing years of last century there was a constant rivalry between the British Cunard and White Star Lines and the American Line as to which could build the fastest ships. In 1889 the American Line claimed the title with the *City of New York* and the *City of Paris*, both steaming at 21 knots; the White Star replied with the *Teutonic* and the old *Majestic*, of the same year; and then came the Cunarders *Campania* and *Lucania* in 1893, capable of 22 knots. Suddenly the German company known as the North German Lloyd came out with their *Kaiser*

By courtesy] *[French Line*

ELEGANCE—THE RESTAURANT OF THE "ILE DE FRANCE"

By courtesy] [*Orient Line*

SPACIOUSNESS—THE DINING SALOON OF THE "ORAMA"

Wilhelm der Grosse in 1897, which promptly lowered the record by steaming across the Atlantic at 23 knots throughout.

With this and succeeding German ships, which further cut the Transatlantic times, the "Blue Riband" remained until 1907, when the Cunard Company, with the financial assistance of the British Government, brought out the *Lusitania* and the *Mauretania*. The former suffered the unhappy fate of being sunk by a German submarine in the Great War. The latter, however, is still hard at work, and it is no exaggeration to say that the *Mauretania* is the most famous British liner afloat. Her dimensions are 762 feet in length, by 88 feet beam by 57 feet depth, giving a gross tonnage of 31,938, and her turbine engines, driving quadruple screws, have a horse-power of 68,000, and are designed to propel the ship at 25 knots.

But this figure has been greatly exceeded, and on one occasion the gallant *Mauretania*, steaming to the assistance of a vessel in distress, travelled at no less than 29 knots. By the year 1908 she had cut the Atlantic crossing, from Cherbourg to the Ambrose

By courtesy] [*Cunard Line*

SUN WITHOUT BREEZE—THE GARDEN LOUNGE OF THE "SAMARIA"

Channel Light, outside New York, to under five days. Her best time of 4 days, 21 hours, 44 minutes westbound, and 4 days, 17 hours, 49 minutes eastbound, remained as Atlantic records until 1929, for twenty-one years continuously.

But once again the same hand as before was outstretched to seize the coveted distinction. In 1929 the wonder-liner *Bremen* of the North German Lloyd appeared on the scene. On her very first voyage, favoured by exceptionally fine weather, she cut the westbound time to 4 days, 17 hours, 24 minutes, and on the return journey a time of 4 days, 15 hours, 30 minutes was achieved, the *Mauretania* being thus beaten in both directions. The "old lady," as the latter is affectionately called, put up a marvellous reply to this challenge, and at the mature age of twenty-one years, helped by certain alterations which had been made to her engines and boilers

in the interval, she actually beat her own 21-year record. But for all that she was unable quite to equal the *Bremen's* time, and so for the present the " Blue Riband " rests with Germany. The *Bremen* and her sister ship *Europa* are 51,656-ton liners, designed for 26½ knots, but now proved capable of crossing the Atlantic at a rate of 28 knots, or 32¼ miles an hour, throughout.

The advent of the *Bremen* has caused all the old rivalries to break out more fiercely than ever. And in the competition now developing both size and speed are concerned. Just before the War, the Hamburg-American Line of Germany, believing in size rather than speed, built three giant liners, the *Imperator*, the *Vaterland* and the *Bismarck*. Under the terms of the peace treaty, the first and last of these were handed over to Great Britain, and became respectively the *Berengaria* of the Cunard Line and the *Majestic* of the White Star Line.

By courtesy] [*Orient Line*

FOR HEALTH AND RECREATION—THE BOAT DECK OF THE " OTRANTO "

The *Vaterland*, transferred to the American flag, became the *Leviathan* of the United States Lines. All three liners have gross tonnages between 55,000 and 60,000 tons, and they are the largest trio afloat. During the last 18 years no liners comparable in size have been built, other than the 43,548-ton *Ile de France* of the French Line, the tendency having been towards ships of more moderate size, with ample cargo capacity and comfortable accommodation, which are far less costly to build and run, and by which lower fares and rates can be charged.

Now, however, new giant liners are to be built in which all existing records in size and speed will go by the board, and five countries are involved in the race. Two Italian shipping companies—the Navigazione Generale Italiano and the Lloyd Sabaudo—have 50,000-ton liners under construction designed for a speed of 28 knots. The French Line contemplates a 60,000-ton vessel of 28 knots, and the Americans are talking of two more *Leviathans*, each of 60,000 tons and 27½ knots'

By courtesy] *[Orient Line*

A Remarkable View on the "Orontes"

speed. The White Star Line of Great Britain has laid down the keel of a new *Oceanic*, which is to be of 65,000 tons gross, and rated at 26 knots. But the two *super-Aquitania* class vessels which have been commenced by the British Cunard Line will leave all these figures in the shade. Their tonnage will be 75,000 tons each and their designed speed from 29 to 30 knots!

By courtesy] [*Orient Line*

A Glimpse of The Main Staircase and Lift of the "Orama"

The photographs in this chapter have been specially chosen to give you some idea of the interior of a luxury-liner of to-day. We will start with a tour of the bedrooms. In the first-class staterooms bunks are a thing of the past, and every passenger is provided with a bed, as well as with such luxuries as hot and cold running water, electric radiators, big cupboards, efficient lighting, and everything that makes for comfort and sound sleep. Many of these cabins have their own bathrooms attached. The very latest effects in furnishing and colour make the stateroom a most delightful "home" for the passenger during the voyage. In the second-class and third-

By courtesy] *[French Line*

FOR THE CHILDREN—A "PUNCH AND JUDY" SHOW AT SEA

class, space is more precious, and many of their cabins contain two or four berths, but comforts are unceasingly on the increase, and all liner passengers, no matter by what class they are travelling, are wonderfully well treated nowadays.

Accommodation for meals must, of course, be on an enormous scale, as over three thousand people at a time may require meals. In order to make for spaciousness, the first-class dining saloons are often carried up through two decks to domed

By courtesy] *[Royal Mail*

A CHILDREN'S PLAYROOM ON THE "ALCANTARA"

By courtesy] [*French Line*

THE CHAPEL ON THE "ILE DE FRANCE"

or vaulted roofs, such as the handsome saloon of the *Orama* on p. 85, or the elegant "restaurant" of the *Ile de France*, shown on p. 84. The restaurant is really a substitute for the dining saloon proper; it is provided for those who want to order their meals as they choose, rather than take the lengthy *table d'hôte* meals. On other ships a "grill-room" is provided, such as that of the Cunarder *Aquitania*, illustrated on p. 83.

Then there are the various rooms for rest and recreation, and here the ingenuity of those who plan interior furnishings is exercised to the very full. Look at the remarkable first-class smoking-room of the *Carinthia*, on p. 92, designed like an old baronial hall, even down to a knight in armour! Or, by contrast, at the first-class lounge and a corner of the smoking-room on the *Bremen*, with the very

By courtesy] [*Cunard Line*

THE ANTIQUE—FIRST-CLASS SMOKING ROOM OF THE "CARINTHIA"

latest in modern decorative schemes. Or, yet again, at the corridor and the palm lounge of the *Homeric*, which both appear in one of the coloured plates. Who would have dreamed, a century ago, of finding such things as these on board ship? Many other developments might be mentioned, such as the chapel which has been permanently installed on the *Ile de France*, as you may see on p. 91; and on the same liner children are specially catered for by a "Punch and Judy" show. Many of the big modern ships provide special playrooms for children, like the jolly one on the *Alcantara*, shown on p. 90, which helps so much to pass the time away on long voyages to and from South America.

Perhaps the best of all the impressions of interior size are given by some of the pictures of entrance halls, stairways and corridors. The lounge of the *Orontes*, with its fluted pillars, is a particularly fine example, and the main staircase of the *Orama*, with the lift door in the background, forms another striking picture, far removed from the conception that most of us probably have of life at sea. Most of the big liners to-day, too, boast several shops in their corridors

or their lounges.

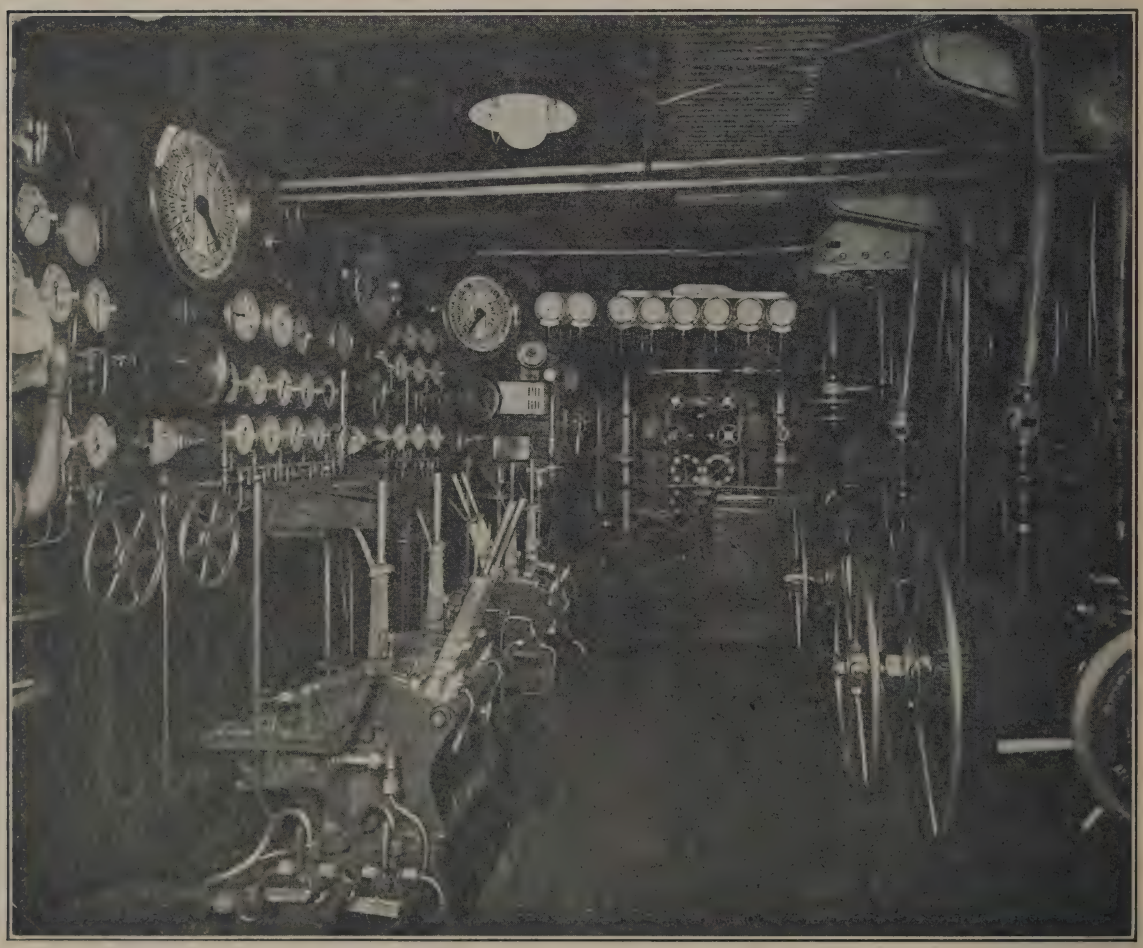
But not all the voyage is spent by the passengers " between decks." Nothing is pleasanter on a fine trip than to be out in the sunlight, and the broad and beautifully-kept decks of the large liner offer every possible opportunity for games, or for walking, or for sitting comfortably and reading. The boat deck of the *Otranto*, which you see on p. 87, is a fine example of modern roominess on deck, and you will see how arrangements are provided for covering it in during the very hot weather through which Orient liners pass on their way to and from Australia. And then the sunlight without the breeze may be enjoyed in such charming surroundings as those of a modern garden lounge, such as that of the *Samaria*, which you see on p. 86, prepared in alluring fashion for afternoon tea.

An upper-deck diversion of considerable interest in these days is the provision of an aeroplane, with a " catapult " device which enables it to be launched while the vessel is at sea. At the stern end of the *Ile de France*, in the illustration on p. 1, you see the hangar

By courtesy] [*Norddeutscher Lloyd*

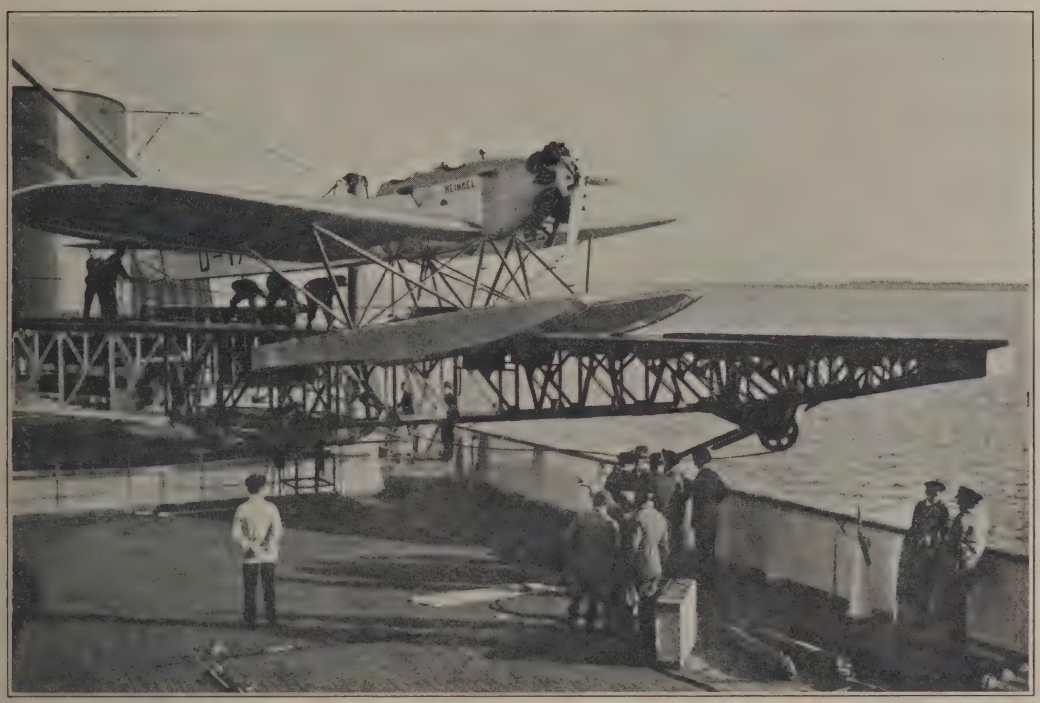
THE MODERN—A CORNER OF THE SMOKING ROOM ON THE " BREMEN "

and the runway for one of these 'planes; and opposite, on board the *Bremen*, is the 'plane itself. The idea of this innovation is the more rapid handling of mails. As the *Bremen* approaches the West coast of Ireland, the aeroplane, loaded with the mails, is launched, and flies direct to Southampton or London, continuing from there to Germany. In this way the mails for England save a day, and those for Germany a full two days, as compared with carrying the mails through on the liner herself.



By courtesy] *[Cunard Line*

THE STARTING PLATFORM OF THE "AQUITANIA"



By courtesy] *[Norddeutscher Lloyd.*

THE MAIL AEROPLANE AND CATAPULT ON THE BREMEN

We are never satisfied. There must always be improvement, and so it is that the ship designer is constantly faced with greater and greater demands on his skill and his ingenuity. More speed, more size, more luxury—each addition brings its own special problems, and every problem overcome is only the prelude to others which must be faced. We have little idea, for example, of the complex difficulties involved in the design of ships of such prodigious proportions and power as the two 75,000-ton Cunarders about to be built. When their turbines are running "all out," they will need to develop between 190,000 and 200,000 horse-power. This is from 80,000 to 90,000 more than the rated horse-power of the *Bremen*, and affords a striking comparison with the modest 75,000 horse-power of the *Mauretania*—hitherto the fastest Transatlantic liners afloat.

By courtesy] [*White Star*

A 56,620-TON FISH OUT OF WATER. THE "MAJESTIC" IN THE FLOATING DOCK AT SOUTHAMPTON.

The new Cunarders will carry four thousand passengers apiece, and when they sail with a full passenger list will have nearly five thousand souls on board. Owing to the tremendous stresses and strains set up by such powerful machinery, the type of construction decided on is pretty nearly equal in strength to that of a battle-cruiser, but at the same time vibration from machinery is to be non-existent, even at full speed. New standards of safety at sea will be set up. So carefully are the hulls to be divided up into water-tight compartments that even were one of these ships to be extensively holed below the water-line she would still remain afloat. All honour to the Cunard Company! May they add to their Transatlantic reputation of nearly a century by restoring to the British flag all the shipping records for size, speed and safety!

Phillips Library
My book of ships : their building and th
VM381.A5 1928
3 6234 01021591 4